Cardiology

Advanced Training Curriculum

Paediatrics and Child Health Division

The Royal Australasian
College of Physicians

The Cardiac Society of
Australia and New Zealand

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Physician Readiness for Expert Practice (PREP) Training Program

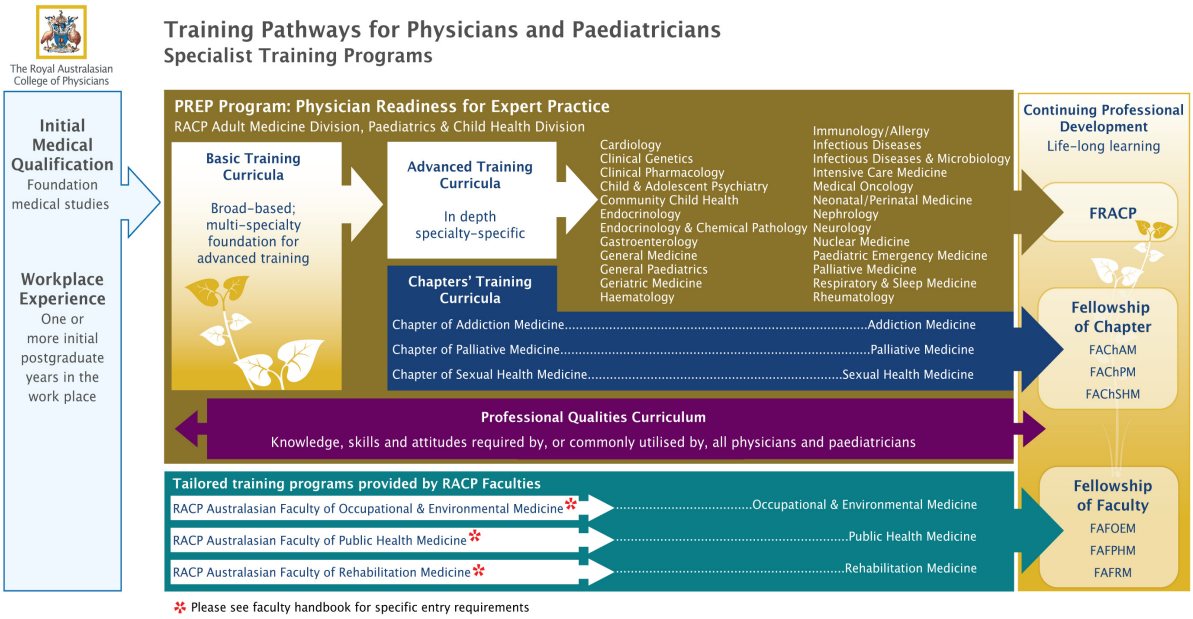
Cardiology Advanced Training Curriculum

To be used in conjunction with:

Basic Training Curriculum – Paediatrics and Child Health

Professional Qualities Curriculum

PHYSICIAN AND PAEDIATRICIAN TRAINING CONTINUUM OF LEARNING



The schematic depicts the interrelationship between the various RACP Training program curricula components. In particular it emphasises the underpinning nature of the Professional Qualities Curriculum.

It also reinforces the link from initial medical training through PGY1/2, leading into Basic/Advanced/Faculty/Chapter training and following on into Continuing Professional Development (CPD).

OVERVIEW OF THE SPECIALTY

Paediatric cardiologists are subspecialty paediatricians with special expertise in the diagnosis and management of congenital and acquired cardiac disorders and multisystem disorders. They are able to coordinate patient care and work within the multidisciplinary team to optimise health outcomes for individuals and groups. The paediatric cardiologist has a breadth of expertise. This extends across acute hospital to ambulatory settings. The paediatric cardiologist manages patients in contexts which meet their care needs. Notable rewards include the privilege of being able to offer 'secondary' care to the same person at different times, for different conditions, and provide family centred care. Many of the clinical scenarios faced by paediatric cardiologists require a high level biopsychosocial approach.

Paediatric cardiologists ensure the delivery of efficient, cost-effective and safe care for the community and contribute to workforce development as leaders in medical education and health policy.

A paediatric cardiology medical career has inherent challenges in dealing with complex and technically demanding medical issues, and in developing the capacity to adapt to changes within social and political milieu, however, provides much personal and professional satisfaction.

As a paediatric cardiologist you may be working either in salaried hospital and / or private medical practice. Many paediatric cardiologists choose to have the “best of both worlds”. Paediatric cardiologists practice in metropolitan tertiary teaching children’s hospitals, but also provide outreach consulting services to regional and rural centres. In Australasia, paediatric cardiologists only see referred patients. In addition to patients referred from primary care, paediatric cardiologists are referred patients with acute or chronic problems from other paediatricians, where the cardiac pathology remains undefined, complex or multi-system in nature.

Academic and research opportunities also exist within paediatric cardiology particularly in the areas of clinical epidemiology and health systems performance.

Importance of the role of this specialty

With improved medical and surgical outcomes in children with acquired and congenital heart disease, children are living longer with complex, chronic and multi-system problems. Many of our children now survive well into adulthood. Increasing subspecialisation results in more health care providers and potentially increases both the direct and indirect costs of health care without necessarily improving outcomes. There is an increasing need for coordinated, effective and patient-centred care. The primary goal of health care systems should be to deliver high-quality care within economic constraints. The best way to do that is to identify the optimal mix of providers on the basis of local health needs and measurable outcomes and create structures necessary to facilitate high-quality care. Generalists working alongside subspecialists may provide the best care, through combining “breadth” with depth (Ayanian JZ. NEJM 2002; Nash DB, Nash IS. Ann Int Med 1997; 172:72-73).

Crisis in our systems for admitted patients, technological advances and respect for the choice of individuals to include management within their own environment has led to a greater dependence on ambulatory care. Paediatric cardiology also has the potential to provide the necessary support to general practice in ambulatory and sometimes in admitted patient settings. The paediatric cardiologist can provide a “one-stop assessment”, determining the nature of the pathology and coordinating the involvement of other practitioners to simplify the system for children and their families and reduce the risk of error.

Increasing demand for hospital beds also requires that hospitalisation be more efficient as well as providing better and safer care. Paediatric cardiologists now work alongside emergency and intensive care physicians in many hospitals to fast track and co-ordinate the care of children with acquired and congenital heart disease from the outset.

Challenges for the specialty

The major challenge for paediatric cardiology is to provide better, safer and more efficient care in all settings.

As with other professionals, paediatric cardiologists need to be cognisant of, and sensitively respond to, evolving societal, workplace, legislative and technological developments.

Paediatric cardiology also needs a greater workforce. Where workforce shortages exist, paediatric cardiologists need to be able to adapt to work closely with general paediatricians and general practitioners to ensure that the subspecialist's expertise is fully utilised in the development of programs to deliver care in safe, innovative, effective and efficient ways. This is particularly important in the regional and rural settings.

Paediatric cardiologists also need to ensure that the public and profession are fully aware of their important role in health care delivery. It is critical for survival of the health system that paediatric cardiologists are available and fully utilised. The specialty needs to be valued in order to grow and make greater contributions.

CURRICULUM OVERVIEW

Paediatric Cardiology – Advanced Training Curriculum

This curriculum outlines the broad concepts, related learning objectives and the associated theoretical knowledge, clinical skills, attitudes and behaviours required and commonly utilised by Paediatric Cardiologists within Australia and New Zealand.

The purpose of advanced training is for trainees to build on the cognitive and practical skills acquired during basic training. At the completion of the Paediatric Cardiology Advanced Training program, trainees should be competent to provide at consultant level, unsupervised comprehensive medical care in Paediatric Cardiology.

Attaining competency in all aspects of this curriculum is expected to take three years of training. It is expected that all teaching, learning and assessment associated with the Paediatric Cardiology Curriculum will be undertaken within the context of the physician's everyday clinical practice and will accommodate discipline-specific contexts and practices as required. As such it will need to be implemented within the reality of current workplace and workforce issues and the needs of health service provision.

There may be learning objectives that overlap with or could easily relate to other domains; however, to avoid repetition, these have been assigned to only one area. In practice, however, it is anticipated that within the teaching/learning environment, the progression of each objective would be explored.

Trainees who for various reasons wish to undertake only one year of advanced training in paediatric cardiology (as an elective year for another subspecialty, or at the start of advanced training while waiting to enter another subspecialty career path) will need to use this curriculum to prepare their own learning plan for the year. They should aim to focus particularly on those learning objectives which achieve least coverage in their anticipated complementary training. Trainees aiming to complete all of their core training in two years should aim to cover ~50% of the outlined learning objectives per year.

Note: The curricula should always be read in conjunction with the relevant College Training Handbook available on the College website.

Professional Qualities Curriculum

The Professional Qualities Curriculum (PQC) outlines the range of concepts and specific learning objectives required by, and utilised by, all physicians, regardless of their specialty or area of expertise. It spans both the Basic and Advanced Training programs and is also utilised as a key component of the Continuing Professional Development (CPD) program.

Together with the various Basic and Advanced Training Curricula, the PQC integrates and fully encompasses the diagnostic, clinical, and educative-based aspects of the Physician's / Paediatrician's daily practice.

Each of the concepts and objectives within the PQC will be taught, learnt and assessed within the context of everyday clinical practice. It is important, therefore, that they be aligned with, and fully integrated into, the learning objectives within this curriculum.

EXPECTED OUTCOMES AT THE COMPLETION OF TRAINING

Graduates from this training program will be equipped to function effectively within the current and emerging professional, medical and societal contexts. At the completion of the advanced training program in Paediatric Cardiology, as defined by this curriculum, it is expected that a new Fellow will have developed the clinical skills and have acquired the theoretical knowledge for competent Paediatric Cardiology practice. It is expected that a new Fellow will be able to:

- Undertake timely, comprehensive and systematic clinical assessments of congenital and acquired heart disease
- Efficiently formulate diagnosis and management plans in partnership with patients and families
- Provide a learned, comprehensive, rational, evidence based consultant opinion
- Prioritise care according to clinical circumstances and treatment goals
- Care for patients and their families from the antenatal period, through the postnatal period and childhood to adolescence
- Care for a diversity of patients with multiple problems
- Care for acute and chronic undifferentiated illness and well-defined clinical syndromes
- Show willingness and capability to manage a diverse spectrum of clinical problems and patient case mix in a variety of clinical settings
- Demonstrate rational, cost-effective and appropriate use of interventions, investigations and medication
- Competently perform procedures according to current and future practice settings, patient needs, and credentialing requirements
- Manage patients in spite of clinical uncertainty
- Identify his/her limits to knowledge and seeks additional knowledge and skills
- Respect and operates under the principles of patient autonomy, welfare and social justice
- Demonstrate professional competence and honesty in dealing with others.

CURRICULUM THEMES AND LEARNING OBJECTIVES

Each of the curriculum documents has been developed using a common format, thereby ensuring a degree of consistency and approach across the spectrum of training.

Domains

The Domains are the broad fields which group common or related areas of learning.

Themes

The Themes identify and link more specific aspects of learning into logical or related groups.

Learning Objectives

The Learning Objectives outline the specific requirements of learning. They provide a focus for identifying and detailing the required knowledge, skills and attitudes. They also provide a context for specifying assessment standards and criteria as well as providing a context for identifying a range of teaching and learning strategies.

Minimum Practical Performance Requirements

These outline the minimum set of practical performance requirements to be met. They provide a benchmark for trainees and supervisors to incorporate into their teaching and learning strategies. The minimum practical performance requirements will need to be reached prior to completion of this training program.

LEARNING OBJECTIVES TABLES

DOMAIN 1	PROFESSIONAL QUALITIES OF A PAEDIATRIC CARDIOLOGIST
Theme 1.1	**Patient Care and Management**
Learning Objective	
1.1.1	Assess and manage patients with cardiac problems
Theme 1.2	**Advocacy and Health Systems**
Learning Objective	
1.2.1	Contribute to improved systems of care to meet current and future health needs of children with congenital and acquired heart disease
Theme 1.3	**Evidence Based Practice**
Learning Objective	
1.3.1	Investigate, appraise and apply scientific evidence in medical practice

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.1	**Neonatal / Perinatal Cardiovascular Disorders**
Learning Objectives	
2.1.1	Detect and manage fetal cardiac abnormalities
2.1.2	Assess and treat cyanotic newborn infants
2.1.3	Assess and treat infants who present with cardiovascular collapse
2.1.4	Assess and advise on the treatment of cardiovascular problems commonly arising in the context of neonatal intensive care
2.1.5	Assess and treat cyanotic children presenting after the newborn period
Theme 2.2	**Heart Diseases and Presentations**
Learning Objectives	
2.2.1	Assess and treat children with cardiac murmurs
2.2.2	Assess and treat patients with chest pain, presyncope and syncope
2.2.3	Assess and treat patients with arrhythmias
2.2.4	Assess and treat children who are critically ill with severe haemodynamic disturbance
2.2.5	Assess and treat cardiac failure in infants and children
2.2.6	Assess and treat patients with inflammatory cardiovascular disease, including Kawasaki disease
2.2.7	Assess and treat patients with stridor
2.2.8	Assess and treat patients with rheumatic fever and valvular heart disease
2.2.9	Assessment and treat patients with cardiac tumours
2.2.10	Assess and treat patients with endocarditis or who are at risk of endocarditis
2.2.11	Assess and treat patients with pericardial disease
2.2.12	Assess and treat patients with cardiomyopathy and myocarditis
2.2.13	Assess and treat patients with risk factors for vascular disease
Theme 2.3	**Congenital and Inherited Heart Disease**
Learning Objectives	
2.3.1	Assess and treat children with genetic disorders and syndromes
2.3.2	Assess and treat children, adolescents and adults with acyanotic congenital heart disease
2.3.3	Recognise nutrition and growth problems related to congenital heart disease and devise strategies to optimise nutritional intake and maximise growth
2.3.4	Assess and treat adolescent and adult patients with congenital heart disease
Theme 2.4	**Conditions Affecting the Circulation**
Learning Objectives	
2.4.1	Assess and treat patients with systemic hypertension
2.4.2	Assess and treat patients with pulmonary hypertension
2.4.3	Assess and treat patients with lipid abnormalities and vascular disease

Domain 3	Surgical Liaison
Theme 3.1	**Care of Surgical Patients**
Learning Objectives	
3.1.1	Assess children requiring cardiac surgery and plan cardiac surgery as part of a multidisciplinary surgical team
3.1.2	Manage patient care following paediatric cardiac surgery
3.1.3	Assess and care for patients following cardiac surgery, including patients after staged palliation for complex congenital heart disease
3.1.4	Assess children with cardiac disease prior to non-cardiac surgery and advise on fitness for such surgery and any precautions or cardiac treatment required
3.1.5	Recognise indications for referral for heart or heart-lung transplantation and provide local care following transplantation
Domain 4	**Procedures, Investigations, and Life Support**
Theme 4.1	**Basic and Advanced Life Support**
Learning Objectives	
4.1.1	Perform and supervise resuscitation of patients
Theme 4.2	**Procedures**
Learning Objectives	
4.2.1	Perform and interpret a 12 lead electrocardiogram (ECG)
4.2.2	Supervise and interpret Holter monitoring, cardiac event recording and exercise testing
4.2.3	Monitor, program and interpret pacemakers
4.2.4	Perform chemical and direct current (DC) cardioversion
4.2.5	Recognise the indications for electrophysiology study and explain the possible therapeutic options, including use of implantable defibrillators and ablative procedures
4.2.6	Explain the principles of cardiac pacing and application of pacing to patient management
4.2.7	Interpret diagnostic and therapeutic electrophysiology
4.2.8	Recognise the indications for tilt testing and evaluate results
4.2.9	Perform and interpret diagnostic cardiac catheterisation and angiography in children and adults with cardiac disease and explain radiation use and safety
4.2.10	Perform a balloon atrial septostomy
4.2.11	Perform pericardiocentesis in the diagnosis and treatment of patients with pericardial disease
4.2.12	Perform diagnostic precordial and contrast echocardiography in newborns, children and adults with congenital heart disease
4.2.13	Perform a transoesophageal echocardiogram and interpret the findings
Theme 4.3	**Imaging**
Learning Objectives	
4.3.1	Interpret a chest x-ray to assist in the diagnosis and assessment of cardiac disease in all ages
4.3.2	Interpret the results of radionuclide imaging, cardiac MRI, and thoracic CT to assist in the diagnosis and assessment of children with cardiac disease and adult congenital heart disease patients

DOMAIN 1	PROFESSIONAL QUALITIES OF A PAEDIATRIC CARDIOLOGIST
Theme 1.1	**Patient Care and Management**
Learning Objective 1.1.1	Assess and manage patients with cardiac problems

Knowledge and Skills

- assess and manage a wide range of common and serious acute symptoms and undifferentiated illness
- assess and manage a wide range of both common and serious congenital cardiac conditions and acquired heart disease
- evaluate the cause(s) of acute deterioration in health status and levels of physical and cognitive functioning especially in those patients with multiple co-morbidities
- ensure safe and competent performance of procedures according to indications
- assess and manage patients with a wide range of sub-acute and chronic presentations in the community
- assess and manage the peri-operative and peri-procedural patient
- identify and manage situations where the available options for acute care are inappropriate and other approaches, such as rehabilitative or palliative care, are indicated
- provide a specialist opinion and assist with the management of patients under the care of others, on referral
- explain complex concepts in a wide range of settings
- form and lead health care teams
- recognise and manage seriously ill patients as part of a multidisciplinary team
- consult and interact with other specialists, and health professionals in supervising patient care.

Teaching and Learning Opportunities

- Inpatient consultations
- Outpatient clinic
- Accident and Emergency Department
- Neonatal Intensive Care Unit
- Paediatric Intensive Care Unit

DOMAIN 1	PROFESSIONAL QUALITIES OF A PAEDIATRIC CARDIOLOGIST
Theme 1.2	**Advocacy and Health Systems**
Learning Objective 1.2.1	Contribute to improved systems of care to meet current and future health needs of children with congenital and acquired heart disease

Knowledge and Skills

- contribute to more integrated, effective and sustainable systems for acute and chronic disease management
- provide leadership for the judicious use of scarce health resources locally, nationally and internationally
- assist individual patients and families in negotiating barriers to safe, effective and equitable care
- explain and navigate bureaucratic complexities associated with patient care
- advocate for children who have difficulty accessing care
- advocate for co-ordinated, patient-centred provision of health care
- recognise social, economic, cultural, and psychological determinants of clinical problems and how they affect management.

DOMAIN 1	PROFESSIONAL QUALITIES OF A PAEDIATRIC CARDIOLOGIST
Theme 1.3	**Evidence Based Practice**
Learning Objective 1.3.1	Investigate, appraise and apply scientific evidence in medical practice

Knowledge and Skills

- acknowledge and manage uncertainty in clinical decision making
- integrate evidence related to questions of diagnosis, therapy, prognosis, risk and cause into clinical decision making
- seek, obtain, critically appraise and apply information from a range of sources
- present succinct synopses of relevant critical appraisals, with recommendations, to patients and their carers and families, and to clinicians and others in the health system
- identify where important evidence is lacking and contribute to initiatives to obtain more evidence, either through further literature searches or through research
- revise clinical heuristics ('rules of thumb') and accepted clinical practices in the light of new evidence challenging their validity
- apply an evidence-based approach to evaluating and optimising quality of care.

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.1	**Neonatal / Perinatal Cardiovascular Disorders**
Learning Objective 2.1.1	Detect and manage fetal cardiac abnormalities

Knowledge	Skills
• recognise indications for fetal cardiac assessment • describe the incidence and risks of fetal cardiac abnormalities • identify normal fetal cardiac anatomy and physiology • describe the associations between fetal cardiac abnormalities and genetic disorders • describe the limitations of fetal echocardiography.	• determine appropriate referral for fetal cardiac assessment • advise parents of the timing and limitations of antenatal diagnosis • recognise when the fetal heart is abnormal • identify common congenital heart defects, abnormal cardiac function and arrhythmias in the fetus • recognise abnormal cardiac function and arrhythmias • formulate and undertake a management plan.

Teaching and Learning Opportunities
• Specialty clinics

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.1	Neonatal / Perinatal Cardiovascular Disorders
Learning Objective 2.1.2	Assess and treat cyanotic newborn infants

Knowledge	Skills
• describe the physiology of cyanosis caused by parallel circulation, common mixing lesions and right heart obstruction with right to left shunting • describe the physiology of duct dependent pulmonary circulation • explain the cardiac causes of cyanosis presenting in the newborn period • describe the natural history, anatomy, physiology and clinical features of congenital heart disease that presents with cyanosis in the newborn period • describe the electrocardiographic (ECG), chest x-ray (CXR) and echocardiographic findings in congenital heart disease that presents with cyanosis in the newborn period • explain the indications, limitations and risks of invasive and non-invasive investigation of congenital heart disease presenting with cyanosis in the newborn period • describe the angiographic and haemodynamic findings at cardiac catheterisation in congenital heart disease that presents with cyanosis in the newborn period • explain the indications and risks of balloon atrial septostomy in newborns with cyanotic congenital heart disease • explain the indications and risks of surgery in congenital heart disease that presents with cyanosis in the newborn period • describe the indications for, and appropriate timing of interventions.	• take a relevant history and perform an examination • interpret ECG, CXR and blood test results • use echocardiography to diagnose abnormalities in cardiac structure or function • distinguish between cardiac and non-cardiac causes of cyanosis in the newborn period • identify incomplete information and plan further investigation • formulate an anatomical and physiological diagnosis on the basis of the clinical information and investigations • identify when there is cyanosis coupled with cardiac failure and initiate medical treatment when necessary • identify the need for a balloon atrial septostomy and perform when indicated • plan and coordinate surgery or catheter intervention • explain the cardiac anatomy, treatment options and prognosis for cyanosis in the newborn period to parents and family members • advise referring practitioners on the management of newborns with cyanosis.

Teaching and Learning Opportunities

- Neonatal and Paediatric Intensive Care Units
- Cardiology ward
- Cardiac Catheterisation Laboratory

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.1	**Neonatal / Perinatal Cardiovascular Disorders**
Learning Objective 2.1.3	Assess and treat infants who present with cardiovascular collapse

Knowledge	Skills
• describe the common causes of cardiovascular collapse in infancy • recognise common arrhythmias which may produce a sudden collapse • identify relevant investigations required to help diagnose and manage cardiovascular collapse.	• rapidly diagnose cardiovascular collapse in the infancy • identify and differentiate between the causes of cardiovascular collapse, including: ▪ acute upper airway obstruction and/or respiratory failure ▪ cardiac abnormality ▪ primary myocardial disease ▪ shock related to blood loss, trauma, severe infection, or metabolic disorders • institute appropriate treatment to bring about stabilisation of the infant and his/her cardiac status • collaborate with other specialists on a multi-disciplinary treatment plan • devise a short term and medium term management plan to achieve a stable outcome if possible while the primary cause is treated.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Cardiology ward
- Intensive care unit

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.1	**Neonatal / Perinatal Cardiovascular Disorders**
Learning Objective 2.1.4	Assess and advise on the treatment of cardiovascular problems commonly arising in the context of neonatal intensive care

Knowledge	Skills
• describe the physiology of transitional circulation • describe the pathophysiology, clinical manifestations, echocardiographic features and treatment of persistent pulmonary hypertension of the newborn • describe the pathophysiology, clinical manifestations and echocardiographic features of patent arterial duct in the preterm child • explain the indications and contraindications for medical and surgical treatment of patent arterial duct in the preterm child.	• differentiate persistent pulmonary hypertension of the newborn from congenital heart disease using echocardiography • perform echocardiography to exclude duct dependent systemic and pulmonary circulation when assessing an infant with a patent arterial duct • identify congenital heart disease in premature and low birth weight infants and make a management plan, including appropriate timing of surgery.

Teaching and Learning Opportunities

- Neonatal Intensive Care Unit

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.1	**Neonatal / Perinatal Cardiovascular Disorders**
Learning Objective 2.1.5	Assess and treat cyanotic children presenting after the newborn period

Knowledge	Skills
• describe the common causes of cyanosis in congenital heart disease beyond the newborn period, their mode of presentation, natural history, symptoms and signs • describe the ECG, CXR and echocardiographic findings of the lesions through the different ages • describe the indications for, and appropriate timing of interventions.	• diagnose the lesions in a clinical setting • order appropriate investigations • use echocardiography to establish diagnosis where indicated • determine when other modalities of investigation are required such as a spiral CT, MRI, or cardiac catheterisation • evaluate the need for surgical / catheter / medical intervention for each of the lesions.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Peripheral clinics
- Inpatient consultations

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	Heart Diseases, Disorders and Presentations
Learning Objective 2.2.1	Assess and treat children with cardiac murmurs

Knowledge	Skills
• describe the characteristics of innocent murmurs • describe the characteristics of the murmurs of common congenital heart abnormalities • describe the pathophysiological basis of the murmurs • describe the investigations required and their likely outcomes for common congenital heart abnormalities • describe the indications for, and appropriate timing of interventions.	• conduct a full cardiovascular examination on the newborn / infant / child / adolescent • perform and interpret the ECG, CXR and echocardiographic findings of the common murmurs noted related to congenital abnormalities • use echocardiography to establish diagnosis where indicated • assess the severity of the cardiac lesion on the basis of the physical signs noted • advise as to the best management options for the common cardiac abnormalities.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Peripheral clinics
- Inpatient consultations

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	Heart Diseases, Disorders and Presentations
Learning Objective 2.2.2	Assess and treat patients with chest pain, presyncope and syncope

Knowledge	Skills
• describe the cardiac and non-cardiac causes of loss of consciousness • describe the clinical features which differentiate arrhythmias, vasovagal syncope and seizures • describe the causes and clinical features of chest pain in childhood • describe the types of structural heart disease which present with chest pain palpitations or syncope • describe the indications for an exercise test, Holter monitor, cardiac-event recorder and tilt-table test to investigate these conditions.	• take a history and perform an examination • interpret 12 lead ECG, identifying substrate for cardiac arrhythmias, ischaemia and hypertrophy • define cardiac structure and function echocardiographically • interpret an exercise test, Holter monitor, cardiac-event recorder and tilt-table test in the context of the history • explain the nature of the diagnosis to patients and family members.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Inpatient consultations

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	Heart Diseases, Disorders and Presentations
Learning Objective 2.2.3	Assess and treat patients with arrhythmias

Knowledge	Skills
• recognise normal electrophysiology of the heart and the mechanisms of arrhythmogenesis • describe the pathogenesis, natural history and prognosis of arrhythmias • describe the methods of presentation and clinical features of arrhythmias from fetal to adult life • describe the types of structural heart disease and types of cardiac surgery associated with abnormal cardiac rhythm • recognise ECG findings of cardiac arrhythmias, and abnormalities seen during event monitoring and exercise testing • describe the pharmacology of drugs used in the treatment of arrhythmias • describe the indications for cardioversion • describe the indications for electrophysiological studies and the use of radiofrequency ablation in the management of arrhythmias • describe the indications for temporary and permanent pacemakers, and implantable defibrillators.	• take a history and perform an examination • devise an investigation plan for a patient with suspected arrhythmias • recognise and manage cardiac arrhythmias from fetal to adult life • select appropriate drug treatment for cardiac arrhythmias • perform and interpret an ECG taken during an adenosine challenge • review and interpret results of event monitoring and exercise stress testing • manage temporary pacing • select patients appropriately for cardioversion and perform cardioversion competently • provide appropriate counselling to the patient and family.

Teaching and Learning Opportunities
• Accident and Emergency Department • Outpatient clinic • Inpatient consultation • Catheter laboratory • Intensive care

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	**Heart Diseases, Disorders and Presentations**
Learning Objective 2.2.4	Assess and treat children who are critically ill with severe haemodynamic disturbance

Knowledge	Skills
• describe the principles of oxygen delivery and consumption • describe the physiology of control of cardiac output • describe the compensatory mechanisms which maintain cardiovascular haemostasis • describe the common causes of haemodynamic instability during childhood and know how to differentiate sepsis, hypovolemia, cardiac failure, cardiac tamponade and hypotension secondary to cardiac rhythm disturbances • explain the principles of extracorporeal life support.	• recognise low cardiac output state • use echocardiography to assist in determining the cause of haemodynamic instability • optimise cardiac output and tissue oxygen delivery with fluid and inotrope support • optimise care with involvement of intensive care and other paediatric specialities • discuss problems of critically ill children with parents and relatives.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Inpatient consultations
- Paediatric intensive care

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	**Heart Diseases, Disorders and Presentations**
Learning Objective 2.2.5	Assess and treat cardiac failure in infants and children

Knowledge	Skills
• describe the aetiology, pathophysiology, diagnosis and management of heart failure • describe the natural history and clinical presentation of patients with heart failure, in particular the clinical features at different ages from newborn to adult life • describe the ECG, CXR and echocardiographic findings in cardiac disorders that present with cardiac failure • describe the angiographic and haemodynamic findings at cardiac catheterisation in congenital heart disease that presents with cardiac failure • describe the indications for and pharmacology of drugs currently used in the treatment of heart failure • describe the complications of pharmacological treatment in patients with heart failure • describe the indications for referral for surgical interventions including surgical repair, extracorporeal mechanical support and cardiac transplantation.	• take a history and perform an examination • select and interpret investigations appropriately • use echocardiography to diagnose abnormalities in cardiac structure or function • plan further investigation if required • select appropriate drug therapy for individual patients with heart failure • optimise nutrition and manage failure to thrive caused by cardiac failure • plan and coordinate surgery or catheter intervention where necessary.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Cardiology ward
- Inpatient consultations
- Intensive Care Unit
- Outpatient clinic

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	Heart Diseases, Disorders and Presentations
Learning Objective 2.2.6	Assess and treat patients with inflammatory cardiovascular disease, including Kawasaki disease

Knowledge	Skills
• describe the pathology and natural history of Kawasaki disease and collagen vascular disease affecting the cardiovascular system • describe the cardiac and non-cardiac manifestations of these disorders • describe the echocardiographic features of these disorders • explain investigation and treatment options for acute and chronic Kawasaki disease.	• recognise the clinical features of Kawasaki disease and carry out echocardiographic examination of the coronary arteries • devise acute and long-term treatment and follow-up plans for patients with Kawasaki disease • perform coronary angiography in children.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Inpatient consultations
- Specialty clinics
- Cardiac catheter lab

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	Heart Diseases, Disorders and Presentations
Learning Objective 2.2.7	Assess and treat patients with stridor

Knowledge	Skills
• describe the embryology, anatomy and natural history of vascular rings and slings • describe the use and limitations of echocardiography and other imaging modalities in identifying vascular rings • recognise signs of vascular rings on CXR and barium swallow • describe angiographic, MRI and CT features of vascular rings and slings • explain the surgical options for release of vascular rings and slings.	• perform echocardiography to identify the presence of and define the anatomy of vascular rings and slings • select patients who warrant further investigation by other imaging modalities • interpret aortic and pulmonary artery anatomy on angiographic, MRI and CT imaging • plan appropriate surgery for release of vascular rings or slings.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Inpatient consultations
- Specialty clinics
- Cardiac catheter lab

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	Heart Diseases, Disorders and Presentations
Learning Objective 2.2.8	Assess and treat patients with rheumatic fever and valvular heart disease

Knowledge	Skills
• describe the epidemiology of rheumatic fever • describe the aetiology and pathophysiology of rheumatic fever and rheumatic heart disease • describe the diagnostic criteria for rheumatic fever • explain treatment options for acute rheumatic fever • describe the echocardiographic features of rheumatic heart disease • discuss the surgical management of rheumatic valvular disease • discuss recommendations for antibiotic prophylaxis.	• take a history and perform an examination • select and interpret appropriate haematological investigations and non-invasive imaging • medically manage acute rheumatic fever and rheumatic carditis • determine the requirement for and timing of surgical intervention • explain the long-term management of rheumatic fever to patients and family members.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Inpatient consultations
- Cardiac theatre

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	Heart Diseases, Disorders and Presentations
Learning Objective 2.2.9	Assessment and treat patients with cardiac tumours

Knowledge	Skills
• describe the pathology, presentation and natural history of cardiac tumours • describe the indications, limitations and benefits of investigations used in the assessment of cardiac tumours • explain the urgency of intervention for specific tumours.	• take a history and perform an examination • select and use appropriate investigations • use echocardiography to diagnose cardiac tumours and assess their impact on surrounding structures and cardiac function • plan further investigation if required • plan and coordinate surgery where necessary.

Teaching and Learning Opportunities

- Inpatient consultations
- Outpatient clinic

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	**Heart Diseases, Disorders and Presentations**
Learning Objective 2.2.10	Assess and treat patients with endocarditis or who are at risk of endocarditis

Knowledge	Skills
• describe the pathogenesis, presentation and natural history of endocarditis • list the common pathogens involved • explain the diagnosis, investigation, treatment and monitoring of patients with endocarditis • describe the indications and limitations of echocardiography and other investigations in the diagnosis and management of endocarditis • describe the possible complications of endocarditis • describe the indications for surgical intervention • describe the guidelines for endocarditis prophylaxis.	• take a history and perform an examination • select and use investigations appropriately • manage patients with endocarditis • integrate information and advice from microbiologists and cardiac surgeons • advise patients on prevention strategies for endocarditis.

Teaching and Learning Opportunities
• Accident and Emergency Department • Outpatient clinic • Inpatient consultations

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	Heart Diseases, Disorders and Presentations
Learning Objective 2.2.11	Assess and treat patients with pericardial disease

Knowledge	Skills
• describe the pathogenesis, natural history and prognosis of pericardial diseases • describe the modes of presentation of pericardial disease • describe the pathophysiology of tamponade and precautions associated with anaesthesia.	• take a history and perform an examination • select and interpret appropriate investigations, including echocardiography and right heart catheterisation, to diagnose condition • perform pericardiocentesis in appropriately selected patients • recognise and manage cardiac tamponade • recognise and manage pericardial constriction.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Inpatient consultations
- Intensive care

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	Heart Diseases, Disorders and Presentations
Learning Objective 2.2.12	Assess and treat patients with cardiomyopathy and myocarditis

Knowledge	Skills
• describe the different types of cardiomyopathy • describe the pathogenesis, natural history and prognosis of cardiomyopathies and myocarditis • describe the genetic basis for cardiomyopathies, especially hypertrophic cardiomyopathy • explain the role of screening • describe the role of medical therapy, implantable cardioverter defibrillators, catheter-based and surgical-based treatments of cardiomyopathies • describe the indications for transplantation and mechanical support.	• take a history and perform an examination • select, use and interpret investigations appropriately, including echocardiography, MRI, exercise testing and myocardial biopsy • manage cardiac failure and low cardiac output caused by cardiomyopathy or myocarditis.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Inpatient consultations
- Specialty clinics

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.2	**Heart Diseases, Disorders and Presentations**
Learning Objective 2.2.13	Assess and treat patients with risk factors for vascular disease

Knowledge	Skills
• describe the epidemiology of ischaemic heart disease • describe the investigation and management of patients with systemic hypertension (both primary and secondary), lipid disorders, diabetes, smoking and family history of cardiovascular disease • explain the impact of "metabolic syndrome" upon vascular health • calculate an individual patient's absolute risk of cardiovascular disease on the basis of standard risk factors • explain the difference between relative and absolute risk.	• recognise risk factors in coronary heart disease • assess the prevalence of coronary heart disease in the community • manage risk factors appropriately for individual patients.

Teaching and Learning Opportunities
• Outpatient clinic • Inpatient consultations

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.3	**Genetic and Congenital Diseases**
Learning Objective 2.3.1	Assess and treat children with genetic disorders and syndromes

Knowledge	Skills
• describe the fundamentals of human inheritance • describe the principles of molecular genetics and genetic testing • describe the genetics of common inherited heart diseases • describe the molecular pathophysiology of common inherited heart diseases • describe the clinical presentations of common inherited heart diseases • describe the natural history of common inherited heart diseases • explain the screening processes for common inherited heart diseases • describe the cardiac abnormalities found in common genetic disorders • explain the prognosis of genetic syndromes and their associated cardiac disorders.	• take a detailed clinical and family history and develop a pedigree for disease • perform a specific systemic physical examination, including the detection of non-cardiac features • use echocardiography to accurately diagnose abnormalities in cardiac structure or function • interpret ECG abnormalities seen in genetic disorders with arrhythmic potential • interpret and apply genetic testing results to inform diagnosis • explain the recurrence risk in subsequent children to parents.

Teaching and Learning Opportunities

- Inpatient consultations
- Outpatient clinic
- Multidisciplinary clinics

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.3	Genetic and Congenital Diseases
Learning Objective 2.3.2	Assess and treat children, adolescents and adults with acyanotic congenital heart disease

Knowledge	Skills
• describe the common acyanotic congenital heart abnormalities, their incidence, mode of presentation, natural history, symptoms and signs • describe the ECG, chest x-ray and echocardiographic findings of the lesions through the different ages • describe the indications for, and appropriate timing of interventions.	• diagnose the lesions in a clinical setting • select and interpret appropriate investigations • use echocardiography to establish diagnosis where indicated • determine when other modalities of investigation are required such as a spiral CT, MRI, or cardiac catheterisation • evaluate the need for surgical / catheter / medical intervention for each of the lesions.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Peripheral clinics
- Inpatient consultations

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.3	Genetic and Congenital Diseases
Learning Objective 2.3.3	Recognise nutrition and growth problems related to congenital heart disease and devise strategies to optimise nutritional intake and maximise growth

Knowledge	Skills
• describe the causes of growth failure in children with congenital heart disease • determine fluid and caloric intake in children with cardiovascular disease • determine fluid balance after cardiac surgery • describe the indications for parenteral nutrition and its management • describe the causes of chylothorax and dietary management in the treatment of this condition.	• recognise failure to thrive and be able to identify cardiac and non-cardiac aetiologies • plan and monitor feeding regimes in children with cardiac failure • recognise the importance of nursing staff and dieticians in supervising and advising on nutrition • decide the appropriate timing for surgical intervention when there is a failed response to dietary intervention • manage fluid intake and fluid balance after cardiac surgery.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Inpatient consultations

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.3	**Genetic and Congenital Diseases**
Learning Objective 2.3.4	Assess and treat adolescent and adult patients with congenital heart disease

Knowledge	Skills
• describe the natural history of congenital heart disease into adolescence and adult life • describe the common rhythm disturbances in adult congenital heart disease and treatment options • describe the indications for investigation in the adolescent and adult age group • explain the long-term sequelae for surgery for congenital heart disease • explain the implications of congenital heart disease for contraception and pregnancy.	• take a history and perform an examination • select and interpret appropriate investigations • manage patients with congenital heart disease • liaise with adult congenital heart disease specialists • counsel patients with congenital heart disease regarding exercise and employment • counsel patients with congenital heart disease regarding contraception and pregnancy • arrange transition from the paediatric to adult congenital service.

Teaching and Learning Opportunities

- Outpatient clinic
- Inpatient consultation
- Multidisciplinary meetings

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.4	**Conditions Affecting the Circulation**
Learning Objective 2.4.1	Assess and treat patients with systemic hypertension

Knowledge	Skills
• describe the causes of hypertension • describe the investigation of a patient for secondary hypertension • describe the pharmacology of drugs currently used in the treatment of hypertension • explain non-pharmacological treatment options • describe the management of a patient with resistant hypertension • describe the protocols and management plans for hypertension.	• interpret ambulatory blood pressure recordings • interpret appropriate biochemical investigations and imaging modalities • diagnose and assess hypertension • manage patients with hypertensive emergencies.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Inpatient consultations

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.4	Conditions Affecting the Circulation
Learning Objective 2.4.2	Assess and treat patients with pulmonary hypertension

Knowledge	Skills
• describe the physiology of pulmonary hypertension • distinguish disease which is secondary to a congenital heart defect from primary pulmonary vascular disease • describe the congenital and acquired cardiac defects that can cause pulmonary hypertension • describe the natural history of pulmonary hypertension, including symptoms and signs • describe the indications, limitations, risks and predictive value of non-invasive and invasive investigations • explain the medical management of pulmonary hypertension • explain the role of heart-lung transplantation.	• take a history and perform an examination • select and interpret appropriate investigations • interpret haemodynamic measurements and right heart catheterisation • determine when pulmonary vascular disease prohibits surgical correction of congenital heart disease • manage pulmonary hypertension and its long term complications.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Inpatient consultations
- Cardiac catheter laboratory

DOMAIN 2	DISEASES AND PRESENTATIONS
Theme 2.4	**Conditions Affecting the Circulation**
Learning Objective 2.4.3	Assess and treat patients with lipid abnormalities and vascular disease

Knowledge	Skills
• describe the normal and abnormal lipid biochemistry • describe the epidemiology and pathophysiology of lipid disorders • describe the investigation and management of patients with lipid disorders • describe the pharmacology of drugs currently used in the treatment of lipid disorders • explain the evidence for pharmacological intervention in both primary and secondary prevention.	• interpret lipid results relevant to individual patients • explain management strategies to patients • recommend family screening where appropriate.

Teaching and Learning Opportunities

- Inpatient consultations
- Specialist lipid clinic
- Outpatient clinic

DOMAIN 3	SURGICAL LIAISON
Theme 3.1	**Care of Surgical Patients**
Learning Objective 3.1.1	Assess children requiring cardiac surgery and plan cardiac surgery as part of a multidisciplinary surgical team

Knowledge	Skills
• identify cardiac surgical procedures used in the treatment of congenital heart disease • describe the clinical and investigational assessment required to safely plan cardiac surgery • explain the risks and benefits of each surgical procedure • define the factors which place the child at increased risk from cardiac surgery • describe the principles of cardiopulmonary bypass and the risks involved.	• clinically assess cardiac status and determine the most appropriate timing for cardiac surgery • explain the indications for, nature of and complications of the planned cardiac surgery to children and family members • present relevant clinical details and results of investigations to allow planning for surgery • plan surgery as a member of a multidisciplinary surgical team.

Teaching and Learning Opportunities

- Outpatient clinic
- Inpatient consultations
- Operating theatre
- Paediatric intensive care

DOMAIN 3	SURGICAL LIAISON
Theme 3.1	Care of Surgical Patients
Learning Objective 3.1.2	Manage patient care following paediatric cardiac surgery

Knowledge	Skills
• describe the postoperative problems caused by cardiopulmonary bypass • describe the particular problems associated with cardiac surgery for the different types of congenital heart disease, including Norwood and Fontan physiology • describe the techniques to manipulate pulmonary vascular resistance, and the prevention and treatment of pulmonary hypertensive crises • describe the techniques to assess cardiac output and tissue oxygen delivery • explain the long term outcomes for surgical treatment of congenital heart disease.	• interpret readings from invasive arterial and central venous pressure lines • manage fluid balance, electrolyte balance, coagulation abnormalities and inotropic support • diagnose and manage rhythm abnormalities • detect markers of sepsis and institute appropriate investigation and treatment • detect and manage secondary complications involving other organ systems • use echocardiography to assess the results of surgery, cardiac function and presence of pericardial effusions • identify when further evaluation by cardiac catheterisation is required.

Teaching and Learning Opportunities

- Paediatric Intensive Care
- Inpatient consultations
- Outpatient clinic

DOMAIN 3	SURGICAL LIAISON
Theme 3.1	**Care of Surgical Patients**
Learning Objective 3.1.3	Assess and care for patients following cardiac surgery, including patients after staged palliation for complex congenital heart disease

Knowledge	Skills
• describe the long-term outcomes for both corrective and palliative cardiac surgical procedures for congenital heart disease • explain the recommendations for exercise in these patients • explain the risk factors for poor neurological and educational outcome in these patients.	• clinically assess cardiac status and determine satisfactory post-operative progress • perform appropriate investigations to monitor post-operative progress • coordinate multidisciplinary assessment of patients' neurodevelopmental progress • explain the long-term cardiac prognosis to patients and family members • explain the long-term educational and workforce expectations to patients and family members.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Inpatient consultations

DOMAIN 3	SURGICAL LIAISON
Theme 3.1	**Care of Surgical Patients**
Learning Objective 3.1.4	Assess children with cardiac disease prior to non-cardiac surgery and advise on fitness for such surgery and any precautions or cardiac treatment required

Knowledge	Skills
• identify the cardiac disorders associated with a higher risk for general anaesthesia • describe the nature of the planned non-cardiac surgical procedures and physiological impact on cardiac status.	• take a history and perform a clinical examination, determining any relevant change in cardiac condition • select patients who require further investigation • identify patients who are at increased risk from anaesthesia as a result of their cardiac status • explain the impact of cardiac status on the safety of anaesthesia and surgery to patients and family members • liaise with anaesthetic, surgical, and intensive care teams.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Inpatient consultations

DOMAIN 3	SURGICAL LIAISON
Theme 3.1	**Care of Surgical Patients**
Learning Objective 3.1.5	Recognise indications for referral for heart or heart-lung transplantation and provide local care following transplantation

Knowledge	Skills
• describe the indications and contraindications for cardiac transplantation • describe the principles of recipient evaluation • describe the ethical and legal issues in respect of organ donor selection and procurement • describe the principles of immunology and immunosuppression in cardiac transplantation • monitor side effects of immunosuppressive drugs following transplantation • explain the complications of transplantation including problems of graft rejection, infection, immunoproliferative disease and coronary arteriopathy.	• explain the implications of cardiac transplantation, including the prospects of success and long-term outlook, to parents of children with terminal cardiac disorders • determine appropriate referral of patients to transplant centre for recipient evaluation • provide local care following transplantation, in liaison with transplant centre • recognise potential clinical signs of cardiac graft rejection.

Teaching and Learning Opportunities

- Inpatient consultations
- Specialty clinics

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.1	**Basic and Advanced Life Support**
Learning Objective 4.1.1	Perform and supervise resuscitation of patients

Knowledge	Skills
• describe the guidelines on resuscitation • describe the principles of cardiopulmonary resuscitation • describe the cardiac and non-cardiac causes of cardiac arrest • describe the principles and practice of Advanced Life Support.	• supervise pre-hospital care • initiate and perform Basic Life Support • initiate and perform Advanced Life Support • initiate and perform cardiac defibrillation • perform and supervise resuscitation of patients suffering from cardiac arrests and the critically ill.

Teaching and Learning Opportunities

- Accident and Emergency Department
- Outpatient clinic
- Inpatient emergencies
- Operating theatre and intensive care units
- Advanced Life Support course

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.2	**Procedures**
Learning Objective 4.2.1	Perform and interpret a 12 lead electrocardiogram (ECG)

Knowledge	Skills
• demonstrate standard lead placement for paediatric ECG recording • recognise age related changes in ECG wave form • evaluate rhythm, hypertrophy, ischaemia, and infarction on ECG.	• interpret ECG in relation to age related changes • recognise and interpret pathological ECG changes associated with congenital and acquired heart disease • recognise cardiac arrhythmias • perform atrial wire ECG using epicardial pacing wires.

Minimum practical performance requirements

- Interpret and report electrocardiograms on both inpatients and outpatients

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.2	**Procedures**
Learning Objective 4.2.2	Supervise and interpret Holter monitoring, cardiac event recording and exercise testing

Knowledge	Skills
• describe the indications for Holter monitoring, cardiac event recording and exercise testing • describe the normal range of findings on a paediatric Holter monitor • describe the physiology of cardiovascular response to exercise • describe the contraindications to exercise testing in children • recognise normal heart rate and blood pressure response to exercise.	• interpret 24 hour Holter recording • supervise an exercise test and obtain reliable data • interpret results of exercise test • interpret results of cardiac event recorder.

Minimum Practical Performance requirements	
• Supervise and report Holter monitor:	50 cases
• Supervise and report exercise tests:	50 cases

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.2	**Procedures**
Learning Objective 4.2.3	Monitor, program and interpret pacemakers
Learning Objective 4.2.4	Perform chemical and direct current (DC) cardioversion

Knowledge	Skills
• describe the involvement of electrophysiology and cardiac anatomy in pacemaker insertion • define the indications for temporary and permanent pacing • define the principles of monitoring, interrogating and programming pacemakers • define indications for adenosine identification • define the indications for synchronised and unsynchronised DC cardioversion • define the safety precautions required for DC cardioversion • explain the principles of overdrive pacing.	• insert a temporary pacing wire • perform single or dual chamber pacing using epicardial wires in postoperative patients • perform overdrive pacing to treat tachyarrhythmias • diagnose the mechanism of arrhythmia based on the result of adenosine identification • perform cardioversion with adenosine • perform DC cardioversion.

Minimum Practical Performance requirements	
• Perform direct current cardioversion:	5 cases
• Perform an adenosine challenge:	10 cases
• Perform pacemaker testing:	20 cases

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.2	**Procedures**
Learning Objective 4.2.5	Recognise the indications for electrophysiology study and explain the possible therapeutic options, including use of implantable defibrillators and ablative procedures
Learning Objective 4.2.6	Explain the principles of cardiac pacing and application of pacing to patient management
Learning Objective 4.2.7	Interpret diagnostic and therapeutic electrophysiology
Learning Objective 4.2.8	Recognise the indications for tilt testing and evaluate results

Knowledge	Skills
• describe the normal and abnormal electrophysiology of the heart, including fundamental cellular electrophysiology • explain the pharmacology of drugs affecting cardiac electrophysiology • describe the indications for and complications of cardiac electrophysiology studies, including ablation procedures • explain the principles of action of cardiac pacemakers, including implantable defibrillators • describe the indications for and complications of implantation of cardiac pacemakers and defibrillators • describe the electrophysiological complications of pacemakers and common forms of pacemaker dysfunction • describe the principles of pacemaker interrogation and programming • describe the physiological principles of tilt testing.	• participate in implantation of permanent pacemakers • participate in decision making concerning referral for electrophysiology / ablation procedures • participate in electrophysiology / ablation procedures • participate in testing and follow-up of permanent pacemaker implants • supervise and interpret results of tilt table test.

Minimum Practical Performance requirements	
• Observe pacemaker implantation:	5 cases
• Participate in testing permanent pacemaker function:	20 cases
• Participate in clinical decision making for electrophysiology study / ablation procedure, including observation of procedures and interpretation of reports:	10 cases

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.2	**Procedures**
Learning Objective 4.2.9	Perform and interpret diagnostic cardiac catheterisation and angiography in children and adults with cardiac disease and explain radiation use and safety

Knowledge	Skills
• describe the indications for cardiac catheterisation and coronary angiography • explain the complications and adverse events related to cardiac catheterisation • describe the equipment required for cardiac catheterisation • describe the acquisition and interpretation of haemodynamic data • describe the principles of angiogram acquisition including image intensifier angles, magnification, coning and contrast delivery • describe the principles of radiography and radiation safety • describe the indications, contraindication and complications of percutaneous interventions: occlude PDA, balloon dilate pulmonary valve, balloon dilate aortic valve, pulmonary artery angioplasty, recoarctation and angioplasty • describe the basic principles of less common interventions • describe the principles of overdrive pacing.	• plan and supervise pre and post catheter management • interpret clinical information and the results of non-invasive investigations to decide what information must be acquired by cardiac catheterisation • form a detailed plan of how diagnostic cardiac catheterisation is to be performed • obtain safe arterial and venous vascular access • perform catheterisation and pressure measurement of cardiac chambers and pulmonary vasculature • manipulate radiographic imaging planes to obtain multiple diagnostic images • manage common complications arising during and after catheterisation and angiography • carry out haemodynamic calculations and interpret angiographic images correctly • observe and assist in percutaneous interventions • observe trans-septal puncture and myocardial biopsy.

Minimum Practical Performance requirements	
• Perform and report cardiac catheterisation and haemodynamics:	100 cases
• Perform diagnostic cardiac catheterisation as primary operator:	20 cases*

**included in total requirement of 100 cases.*

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.2	**Procedures**
Learning Objective 4.2.10	Perform a balloon atrial septostomy

Knowledge	Skills
• describe the indications for balloon atrial septostomy • describe the techniques for performing balloon atrial septostomy • describe the complications of balloon atrial septostomy.	• explain the risks and benefits of the procedure to patients and family members • perform balloon septostomy via the femoral or umbilical vein • perform transthoracic echocardiography to guide balloon atrial septostomy • supervise the care of infant following procedure.

Minimum Practical performance requirements	
• Perform balloon atrial septostomy cases under supervision: ▪ Demonstrate competency as an independent operator	5 cases

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.2	**Procedures**
Learning Objective 4.2.11	Perform pericardiocentesis in the diagnosis and treatment of patients with pericardial disease

Knowledge	Skills
• describe normal and abnormal pericardial anatomy and surface relations • describe the common causes of pericardial effusions • define the indications for diagnostic and therapeutic pericardiocentesis • define the role of image guidance for pericardiocentesis • define the role of percutaneous vs. surgical drainage.	• identify when pericardiocentesis is indicated • explain the risks and benefits of pericardiocentesis to patients and family members • perform pericardiocentesis and place a pericardial drain • manage cardiac tamponade.

Minimum Practical performance requirements	
• Perform pericardial aspiration under supervision: ▪ Demonstrate competency as an independent operator	3-5 cases

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.2	**Procedures**
Learning Objective 4.2.12	Perform diagnostic precordial and contrast echocardiography in newborns, children and adults with congenital heart disease

Knowledge	Skills
• describe the physics of echocardiography, colour Doppler and spectral Doppler • define the factors determining image quality and resolution • describe the functionality of echocardiography equipment • interpret echo windows and image planes to obtain sequential analysis for paediatric transthoracic echocardiography • recognise the echocardiographic characteristics of all congenital heart defects • describe the assessment of physiology of shunting defects • describe the assessment of valve stenosis and regurgitation • describe the assessment of ventricular function • describe the indications for echo contrast studies • describe the indications for and limitations of fetal cardiac echocardiography.	• manipulate image to obtain optimal image quality • obtain all views during an echocardiographic examination and produce a structured record of the examination • interpret the significance and reliability of information obtained by echocardiography • perform and interpret echo contrast studies • perform echocardiography with sedation.

Minimum Practical requirements

- Transthoracic echocardiograms: 600 studies
  - 300 under supervision of paediatric echocardiographer / cardiologist
  - At least 500 on patients with cardiac pathology
  - All studies should be reviewed and have finalised consultant reports
- Fetal echocardiograms (observation and associated counselling): 20 studies

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.2	**Procedures**
Learning Objective 4.2.13	Perform a transoesophageal echocardiogram and interpret the findings

Knowledge	Skills
• describe the indications for and risks of transoesophageal echocardiography • identify the echocardiographic planes required to display various cardiac structures • recognise the transoesophageal echocardiography appearance of congenital cardiac defects.	• perform transoesophageal echocardiography in the diagnosis of congenital cardiac defects • use transoesophageal echocardiography to guide surgical repair • interpret and report results to surgical team and ICU.

Minimum practical requirements	
• Transoesophageal echocardiograms:	50 studies*
▪ *25 studies as primary operator	
▪ all studies should be reviewed and have finalised consultant reports	

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.3	**Imaging**
Learning Objective 4.3.1	Interpret a chest x-ray to assist in the diagnosis and assessment of cardiac disease in all ages

Knowledge	Skills
• describe the principles of radiation protection • recognise abnormalities of cardiac silhouette produced by congenital heart defects • recognise abnormalities of the radiological appearance of lung fields seen in association with cardiac pathology.	• diagnose abnormalities in cardiac position and cardiac silhouette • recognise lung pathology • use information on chest x-ray to assist in making anatomical and physiological diagnosis in congenital heart disease.

Minimum practical performance requirements
• Interpret chest x-rays

DOMAIN 4	PROCEDURES, INVESTIGATIONS, AND LIFE SUPPORT
Theme 4.3	**Imaging**
Learning Objective 4.3.2	Interpret the results of radionuclide imaging, cardiac MRI, and thoracic CT to assist in the diagnosis and assessment of children with cardiac disease and adult congenital heart disease patients

Knowledge	Skills
• describe the indications for cardiac MRI and CT of thorax • describe the fundamentals of MRI image acquisition • describe the contraindications to performing MRI scanning • interpret information gained from cardiac MRI imaging • describe the indications for radionuclide imaging.	• clinically integrate MRI and CT images of heart and great vessels • clinically integrate results of radionuclide scans, including myocardial perfusion and lung perfusion scans.

Minimum practical requirements	
• Interpret results of cardiac MRI, thoracic CT and radionuclide imaging:	10 (in total)

MINIMUM PRACTICAL PERFORMANCE REQUIREMENTS

The trainee must maintain a logbook of procedures undertaken, which must include the nature of the procedure, diagnosis and findings, any complications of the procedure and the role of the trainee.

In addition, the logbook of echocardiography examinations must include the clinical indication for the test, the nature of the examination, role of the trainee, diagnosis and findings and any complications. The trainee must review the logbook with his / her supervisor each year.

The minimum practical performance requirements are as follows:

Procedures	Minimum number
Adenosine Challenge: Perform an adenosine challenge.	10 cases
Ambulatory care: Manage patients in an ambulatory care (outpatient) setting under supervision.	200 patients
Balloon Atrial Septostomy: Perform balloon atrial septostomy cases under supervision. Demonstrate competency as an independent operator.	5 cases
Cardiac Catheterisation: Perform and report cardiac catheterisation and haemodynamics.	100 cases
Cardiac Catheterisation: Perform diagnostic cardiac catheterisation as primary operator. *(*included in total requirement of 100 cases)*	20 cases*
Direct Current Cardioversion: Perform direct current cardioversion.	5 cases
Echocardiograms: Fetal echocardiograms (observation and associated counselling).	20 studies
Echocardiograms: Transoesophageal echocardiograms: ▪ *25 studies as primary operator. ▪ All studies should be reviewed and have finalised consultant reports.	50 studies*
Echocardiograms: Transthoracic echocardiograms: ▪ 300 under supervision of paediatric echocardiographer / cardiologist. ▪ At least 500 on patients with cardiac pathology. ▪ All studies should be reviewed and have finalised consultant reports.	600 studies
Electrocardiograms: Interpret and report electrocardiograms on both inpatients and outpatients.	
Electrophysiology: Participate in clinical decision making for electrophysiology study / ablation procedure, including observation of procedures and interpretation of reports.	10 cases
Exercise Tests: Supervise and report exercise tests.	50 cases
Holter Monitor: Supervise and report Holter monitor.	50 cases
Imaging: Interpret chest x-rays.	
Imaging: Interpret results of cardiac MRI, thoracic CT and radionuclide imaging:	10 (in total)
Pacemaker: Observe pacemaker implantation.	5 cases
Pacemaker: Participate in testing permanent pacemaker function.	20 cases
Pacemaker: Perform pacemaker testing.	20 cases
Pericardial Aspiration: Perform pericardial aspiration under supervision. Demonstrate competency as an independent operator.	3-5 cases

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