A Framework of Competences for the Special Interest Module in Paediatric Cardiology

April 2012

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Section 1 Introduction

Background to this module

This module is intended for Paediatricians who will lead the District General Hospital delivery of cardiac services within non-specialist settings and therefore wish to develop themselves as Paediatricians with Expertise in Cardiology (PEC).

This module is a revision of the previously published one year British Congenital Cardiac Association (BCCA) and RCPCH curriculum for paediatricians with special expertise in paediatric cardiology, first produced in 2001, and revised in 2007. It is not the curriculum for training as a Paediatric Cardiologist.

The curriculum for training as a Paediatric Cardiologist is separately published by the Joint Royal Colleges of Physicians Training Board in 2010; this curriculum has been extensively modified, and is acknowledged as a key reference, during the development of this module.

In 2010 The National Specialised Commissioning Group produced Service Standards for Paediatric Congenital Cardiac services in England.

The Paediatrician with Expertise in Cardiology (PEC), working within District Children's Cardiology Services (DCCS) and in partnership with Specialist Surgical Centres (SSC) or Children's Cardiology Centres (CCC), is seen as an integral part of current and proposed network models for the organisation and provision of Congenital Cardiac Services

Patients with heart disease should not be managed by PEC in isolation. It is essential to recognise that PEC must develop and maintain governance of their practice by working jointly and in liaison with their SSC or CCC.

Who is this book for?

It is intended for doctors at Level 3 in their General Paediatric training who wish to become Paediatricians with Expertise in Cardiology (PEC), their tutors and educational supervisors. The module may also be useful for Specialty and Associate Specialty Grade doctors (SASG), and post-CCT doctors, who wish to develop their expertise in this area, with the approval of their employing organization. It is anticipated that successful completion of this module will require concentrated attention to the acquisition of knowledge and specialist skills which will ultimately enable the doctor to lead cardiac services for children within DCCS hospitals as part of a clinical network with SSC or CCC.

Why do I need it?

This book gives you and your supervisor guidance about the areas you need to cover in addition to the Framework of Competences for Level 3 Training in General Paediatrics. It gives you a clear picture of what you have to achieve by the end of this module of training.

How do I use the book?

You can sit down with the book on your own and use it to help you identify areas of practice that you need to develop further and those areas in which you feel fairly confident. You can talk to your supervisor about the balance of your experiences and look for ways to ensure you cover all areas you need to.

Progression

Whilst it is acknowledged that the trainee in General Paediatrics who wants to develop expertise in Paediatric Cardiology cannot acquire the same breath and depth of competences as those training purely in Paediatric Cardiology, it is expected that this module will form the basis of a lifelong interest leading to a commitment to build upon the competences acquired during training once in an established Consultant post

A note about the format of this document

This framework sets out the competences that you need to achieve by the end of the module. This document should be used in conjunction with the general competences found within the Framework of Competences for Level 3 Training in General Paediatrics relating to multi-disciplinary management, coordination and organization of care, acute liaison, communication skills etc.

A note about assessment

The statements in this book have been expressed as learning objectives. These are the focus of your training. We will want to assess how well you have achieved these objectives and to be confident that you are fit to practice as a Consultant Paediatrician with expertise in cardiology. The RCPCH Assessment Strategy for Level 3 Training will be used. There is a requirement for additional echocardiography DOPS during this module. Trainees working with their educational supervisors should ensure that the Assessment Strategy is tailored to cover the area of Special Expertise as well as General Paediatrics and that learning and assessment are well documented within the e-portfolio.

Training recommendations

The knowledge and understanding, and skills and behaviours required are outlined below in the Competency Framework. The standards expected for training units are described in Appendix 1 - Standards. Whilst the time taken to achieve all the competences will vary depending on the abilities of the individual doctor, and the amount of clinical experience and training that can be provided in any unit, it is expected that a minimum period of 12 months whole time equivalent spent working in a CCC and/or SSC will be required. However, it is recognised that the achievement of all the competences may be challenging within this period of training alone. It will therefore be essential to develop these competences further through continued professional development both during the remainder of level 3 training and throughout a career as a practicing PEC. In order to facilitate this, each item within the framework has therefore been designated according to the following key:

Marked as 1 – It is expected that these competences will be achieved within 12 months whole time equivalent within training posts.

Marked as 2 – These competences may be partially achieved within the 12 months whole time equivalent training post; however it is anticipated that these will be important areas of attainment during level 3 training and assessment and through further professional development for the practising PEC.

Pilot

This module is being introduced as a pilot. The College will be seeking feedback from the Trainees, Educational Supervisors, Schools of Paediatrics, CSACs and potentially in future from Employing NHS Trusts and Regional Networks. This will look at:

1. Need for training in this module
2. Addition or omission of competences unique to the module
3. Feasibility of delivering the module within Level 3 General Paediatric training
4. Usefulness of the standards for training for the module.
5. Outcome of trainees undertaking the module
6. Need for revision of the competences
7. Need for further assessment

Working group

On behalf of the Paediatricians with Expertise in Cardiology Specialist Interest Group:
Dr. Prakash Dey – Consultant Paediatrician
Dr. Anjum Gandhi – Consultant Paediatrician
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Dr. Roy Sievers – Consultant Paediatrician (Chair)
With acknowledgements to:
The Joint Royal Colleges of Physicians Training Board Paediatric Cardiology Curriculum, 2010
Dr. David Mabin, Dr. Susan Hobbins, Dr. John Simpson, Dr. Robin Martin, John Thomson, and BCCA members for their reviews and advice.

Section 2 Specific Competences in Paediatric Cardiology

The general competences in this section are also applicable when dealing with all the specific conditions that follow in Section 4

Knowledge and Understanding

- Understand the structure of congenital cardiac services in the UK from prenatal screening through to the transition to adult services.
- Understand the role of the Paediatrician with expertise in cardiology (PEC) working as part of a clinical network in close liaison with SSC or CCC to provide local inpatient and outpatient support for children with cardiac conditions.
- Recognise and respond constructively to the challenges presented during and following any reconfiguration of Paediatric Congenital Cardiac Services in England
- The range and role of the professionals within the cardiac network

Skills

- Be able to recognise when cardiac conditions have non-cardiac associations, address these, obtaining specialist help where appropriate
- Be able to offer clear, prioritised, and realistic advice to patients and their families at an understandable level regarding the diagnosis, management, and prognosis of cardiac conditions
- Be able to lead or contribute effectively to multidisciplinary meetings about patient management, either locally or in the specialist cardiac centre
- Be able to work with the specialist cardiac centre to offer non-interventional and follow-up services to patients close to home, whenever safe and practical
- Have the skills, confidence and diplomacy to provide specialist cardiac opinion to other departments within the hospital (e.g. anaesthetics, emergency department)
- Know when specialist cardiac services are needed, be able to communicate the issues clearly and concisely, and liaise effectively to arrange safe and timely transfer to a specialist cardiac centre when necessary

Values and Attitudes

- Understand the lifelong implications of congenital cardiac conditions and the importance of transition from paediatric to adult services
- Recognise and respond to the potential concerns, anxieties and stresses of children and their parents when dealing with the sequelae of a cardiac condition
- Recognise the need to maintain specialist skills through ongoing planned continuous professional development including joint clinics with the specialist cardiologist and attendance at the specialist centre.

Teaching and Research

- Understand the need for accurate and ongoing data collection to allow for local and network audit and quality control
- Understand the role of national databases (e.g. The Central Cardiac Audit Database – CCAD) and multi-centre collaboration to further the understanding of outcomes for children with congenital heart disease
- Provide specialist support and training to paediatric colleagues, primary care colleagues, and trainees regarding cardiac conditions
- Appreciate the need for participation in well designed and conducted research to facilitate improvements in care

Leadership and Management

- Have a clear and confident understanding of personal limitations, recognise and act upon the need to seek additional help in the diagnosis and management and surveillance of children with cardiac conditions
- Develop and maintain strong links with allied SSC and CCC
- Develop and maintain Paediatric Cardiology Services within non-specialist units as part of a managed network in accordance with local and national strategic planning and constraints
- Understand the importance of developing clinical guidelines for the management of children with cardiac conditions
- Have clear understanding of the importance of governance issues related to local and regional care of children with congenital cardiac conditions

Communication Skills

- Be able to offer accurate, sensitive, and age appropriate counseling about risks associated with cardiac conditions to patients and their families
- Be able to offer accurate, understandable lifestyle advice regarding cardiac conditions to empower children, adolescents, and their families in making lifestyle choices
- Understand the importance of effective communication and coordinated team working between different specialists and professional groups in the management of children with cardiac conditions
- Be able to provide information and support school care plans to ensure the safety and minimize the disruption of schooling for children with cardiac conditions
- Be able to signpost support groups and databases with information for children with cardiac conditions and their families.

Section 3 Specific Clinical Competences in Paediatric Cardiology

Growth and Nutrition

To be able to recognise nutrition and growth problems related to congenital heart disease and direct appropriate strategies to optimise nutritional intake and maximise growth	
Know:	
The causes of growth failure in congenital heart disease	**1**
How to manage fluid and calorie intake in children with cardiovascular disease	**1**
Understand the principles of how to manage fluid balance after cardiac surgery	**1**
The indications for supplementary feeding regimens including nasogastric tube feeds	**1**
The indications for parenteral nutrition	**1**
Understand the causes of chylothorax, be familiar with the investigations and management within the specialist centre, including the role and ongoing supervision of a medium chain triglyceride diet	**1**
How drug therapy may affect appetite and biochemical homeostasis with consequent effects on growth	**1**
Know the complications of parenteral nutrition	**1**
Be able to:	
Understand the management of fluid intake and fluid balance around the time of cardiac surgery	
Recognise failure to thrive and be able to identify cardiac and non-cardiac causes	**1**
Identify iron deficiency in patients with cyanotic congenital heart disease	**1**
Recognise the complications of long term nasogastric feeding regimens and the role of specialist speech and language therapists	**1**
Recognise the importance of nursing staff and dieticians in supervising and advising on nutrition	**1**
Provide information to parents about feeding regimes	**1**
Institute and monitor feeding regimes in children with cardiac failure	**1**
Identify when failure to thrive has not responded to optimising nutrition and make timely referral to specialist cardiac team for decision regarding potential surgical intervention in congenital heart disease patients	**1**

Lifestyle

To know about, promote, and support lifestyle measures to minimise cardiovascular risk	
Know:	
The lifestyle risk factors for adverse outcome in patients with cardiac conditions including: • diet • exercise • social deprivation • occupation	**1**
The effect of obesity on health with particular relevance to cardiac conditions	**1**
The effects of smoking on health with particular relevance to cardiac conditions	**1**
The effects of illicit drugs and alcohol on health with particular relevance to cardiac conditions	**1**

Behaviours which can predispose to bacteraemia and expose people with congenital heart to endocarditis (see also Section 4, Topic 10) • Tattooing • Piercings	**1**
Be able to:	
Promote the importance of healthy lifestyle choices	**1**
Recognise patients' current or emergent lifestyle factors or choices which may lead to adverse health outcomes	**1**
Raise and discuss issues of lifestyle with patients and their families to enable them to understand and make healthy lifestyle choices	**1**
Signpost support resources and involve other health professionals to help with lifestyle changes where beneficial	**1**
Suppress any display of personal judgment	**1**

Immunisation and Immunity

To understand, practise and support accepted measures to prevent or minimise severity of infection in children with cardiac conditions	
Know:	
the indications for and timing of active and passive immunisation for children with cardiac conditions (and their families where applicable) in addition to the routine immunisation schedule	**1**
indications for prophylactic measures to minimise severe illness following infective exposures	**1**
the implications of primary and secondary immunodeficiency associated with cardiac conditions or their treatment, and the potential impact on transfusion, immunisation, and other prevention strategies	**1**
Be able to:	
Recognise which patients should receive additional immunisation and refer or organise this appropriately	**1**
Screen for primary immune deficiency and refer patients for immunology assessment and advice when appropriate	**1**
Advise patients, parents and other health professionals about the therapeutic and lifestyle implications and risks of primary and secondary immune dysfunction	**1**
Offer sound advice to patients and their families regarding the secondary effect of cardiac therapies on immunity and immunisation	**1**

Section 4 Condition-specific Competences in Paediatric Cardiology

The following competences are in addition to the general competences in Section 2 which apply to the management of children with all cardiac conditions

Evaluation of a Child with a Cardiac Murmur

To be able to carry out specialist assessment and treatment of children with cardiac murmurs	
Know:	
the range and significance of symptoms associated with congenital and acquired diseases of the cardiovascular system in all ages	**1**
the physical signs that may be found on examination of the cardiovascular system and how to interpret those findings	**1**
the characteristic clinical features of different congenital cardiac defects	**1**
the characteristic features of innocent murmurs	**1**
Understand the likely concerns of parents of children who have been referred for evaluation of a heart murmur	**1**
Understand the limitations of echocardiography and the need to discuss cases with the specialist cardiologist, when appropriate	**1**
Be able to:	
Obtain a relevant history and perform expert cardiac examination	**1**
Discriminate innocent from pathological murmurs on examination	**1**
Make a logical provisional diagnosis on the basis of physical examination	**1**
Refine the provisional clinical diagnosis using ECG and CXR where appropriate	**1**
Use echocardiography to accurately identify normal cardiac structure and function, or recognise and identify abnormality	**1**
Complete the assessment thoroughly and quickly	**1**
Confidently diagnose normality and explain the meaning of an innocent murmur	**1**

Evaluation of the child with Chest Pain, Palpitations or Syncope

To be able to carry out initial assessment and treatment of children and adolescents with chest pain, palpitations, pre-syncope or syncope	
Know:	
The cardiac and non-cardiac causes of loss of consciousness	**1**
The clinical features that discriminate between arrhythmias, vasovagal syncope and seizures in patients with loss of consciousness	**1**
The clinical features that suggest an arrhythmia in patients with palpitations	**1**
The causes of chest pain in childhood	**1**
The clinical features that characterise the various causes of chest pain	**1**
The range of structural heart disease that present with chest pain, palpitations or syncope	**1**

The indications for an exercise test, ambulatory ECG, cardiac event recorder and tilt-table test in the investigation of these conditions and know when these tests should be done under the guidance of the specialist cardiac centre	**1**
The role of genetic testing in families with possible or proven inherited congenital cardiac conditions	**1**
Be able to:	
Take an appropriate detailed history, eliciting all information that may help discriminate between cardiac and non-cardiac causes of chest pain, palpitations and syncope	**1**
Make a logical provisional diagnosis on the basis of history and physical examination	**1**
Identify features on the 12-lead ECG that suggest a substrate for an arrhythmia	**1**
Identify ECG evidence of ischaemic heart disease and ventricular hypertrophy	**1**
Use echocardiography to accurately identify normal cardiac structure and function and to recognise and make a correct initial diagnosis of abnormality	**1**
Make an appropriate plan for further investigation and follow-up	**1**
Complete the assessment quickly in an outpatient setting	**1**
Diagnose normality	**1**
Institute and monitor appropriate treatment for arrhythmias and vasovagal syncope	**1**
Explain the plan for further investigation and the reasons for this line of investigation in terms understandable to the patient and parents	**1**
Explain the likely diagnosis and its impact on lifestyle	**1**
Provide reassurance where there is no organic cause for symptoms	**1**
Refer appropriately to other specialties when a non-cardiac cause is likely	**1**

Arrhythmias

To be able to carry out assessment and treatment of children and adolescents with arrhythmias in liaison with the specialist cardiac centre	
Know:	
The natural history, presentation and clinical features of common arrhythmias from foetus to adolescent	**1**
Know the mechanisms involved in the development of cardiac arrhythmias	**1**
The genetic disorders associated with cardiac arrhythmias and indications for genetic referral	**1**
The types of structural heart disease and types of cardiac surgery associated with arrhythmias	**1**
The characteristic ECG findings of common tachyarrhythmias and bradyarrhythmias, and the features suggesting risk of arrhythmia in the resting ECG	**1**
The indications for exercise testing, ambulatory monitoring, and external loop ECG recording	**1**
The indications for implantable loop recorders, invasive electrophysiology study, radiofrequency ablation and implantable cardiac defibrillators	**1**
Understand the classification, mechanism of action, interactions, side effects, contraindications and clinical use of antiarrhythmic drugs in paediatric patients	**1**
Know the indications for DC cardioversion and defibrillation	**1**
Understand the indications for permanent pacing, the types of cardiac pacing and the indications for each type of pacing in paediatric patients	**2**
Understand the indications, limitations and risks of an invasive electrophysiology study and	**2**

radiofrequency ablation	
The indications for implantable cardiac defibrillators	**2**
Be able to:	
Take a history in a patient with palpitations, perform an expert examination and decide whether an arrhythmia is likely	**1**
Form an appropriate plan of further investigation in a patient with suspected arrhythmias	**1**
Recognise and manage SVT from neonatal to adolescent life, in liaison with SSC or CCC	**1**
Identify the type of arrhythmia present from a 12 lead ECG capturing a rhythm abnormality	**1**
Interpret 24 hour and external loop ECG recordings, and know when to seek further help in interpretation	**1**
Supervise an exercise test and make an initial interpretation of the results	**1**
Perform vagal manoeuvres, DC cardioversion, and defibrillation appropriately in the emergency treatment of tachyarrhythmias	**1**
Explain the rationale, side effects and risks of arrhythmia treatments (including expectant approach) to patients and their families	**1**
Explain the common arrhythmias and their associated risks to patients and their families	**1**
Offer appropriate management options and warning signs to the patient and family	**1**
Provide advice in respect of sports and exercise	**1**
Identify possible inherited cardiac conditions and refer to specialist centre and clinical geneticist	**1**
Appreciate the anxieties caused by arrhythmias to patients and their parents and provide reassurance when the patient is haemodynamically stable	**1**
Understand the importance of patient education in managing ongoing symptoms and determining the most appropriate treatment for each individual	**1**
Know limitations and when to refer to a specialist paediatric cardiologist for expert advice, assessment, and management of arrhythmias	**1**
Perform and interpret an ECG taken during an adenosine challenge	**2**
Be aware of the methods of obtaining telemetry results from implanted cardiac loop recorders and pacemakers	**2**
Select the appropriate emergency treatments and be familiar with the longer term drug treatments used by the specialist unit for common tachyarrhythmias	**2**

Inflammatory Cardiovascular Disease

To be able to carry out preliminary specialist assessment and treatment of children with rheumatic fever, rheumatic heart disease, Kawasaki disease and other inflammatory diseases affecting the cardiovascular system	
Know:	
The pathology and natural history of rheumatic fever, Kawasaki disease and collagen vascular disease affecting the cardiovascular system	**1**
The cardiac and non-cardiac manifestations of these disorders	**1**
The anatomical and echocardiographic features of these disorders	**1**
The current recommendations for investigation and treatment of acute and chronic Kawasaki disease	**1**

The current recommended drug therapy for acute rheumatic fever and the long term sequelae	**1**
Understand the importance of primary and secondary prevention in rheumatic fever	**1**
Be able to:	
Recognise the clinical features of Kawasaki disease and carry out transthoracic echocardiographic examination of the coronary arteries, maintaining an awareness of the difficulties of such assessment and the importance of specialist centre opinion	**1**
Initiate acute management for Kawasaki disease, and liaise with the specialist cardiac centre regarding the long-term management and appropriate follow up programme.	**1**
Be able to identify the features suggesting rheumatic heart disease on transthoracic echocardiography prior to mandatory referral of such cases for specialist centre assessment	**1**
Initiate the acute treatment for rheumatic fever and recognise the indications for referral to the specialist cardiac centre for intervention or surgery in patients with rheumatic heart disease	**1**
Cooperate with other specialties in the investigation of collagen vascular diseases with cardiovascular involvement	**1**
Understand the indications for referral for specialist investigation including coronary angiography in children with Kawasaki disease	**2**

Cardiomyopathy and Myocarditis

To be able to carry out preliminary specialist assessment and treatment of children with cardiomyopathy and myocarditis	
Know:	
The causes, physiology, pathology, natural history, prognosis and clinical features of myocarditis	**1**
The role of genetics in cases of cardiomyopathy and importance of working with the clinical geneticist/inherited cardiovascular disease service	**1**
The range of medical and surgical treatments available for patients with cardiomyopathy and indications for referral	**1**
Be aware of the available forms of circulatory support (LVAD, ECMO)	**1**
Be aware of the role of cardiac transplantation in end-stage cardiomyopathy	**1**
Be familiar with the main causes, physiology, pathology, natural history, prognosis, genetic implications and clinical features of dilated, hypertrophic and restrictive cardiomyopathy	**2**
Be able to:	
Recognise features in the history and examination of myocarditis or cardiomyopathy	**1**
Initiate management of cardiac failure and low cardiac output caused by myocarditis or cardiomyopathy and liaise appropriately with the specialist cardiac centre regarding further management	**1**
Involve the genetics team where appropriate	**1**
Show sensitivity in counselling parents with a child severely affected by cardiomyopathy	**1**
Involve parents in decision making in planning management for end-stage cardiomyopathy in consultation with the SSC or CCC.	**1**
Carry out an initial diagnostic transthoracic echocardiographic evaluation of a child with myocarditis or cardiomyopathy including assessment of cardiac function for discussion with specialist centre	**1**
Exclude conditions which may mimic cardiomyopathy including coronary artery assessment	**2**
Recognise the likely prognosis given by the specialist centre and be able to discuss this with the family if required	**2**

Consider other aspects of disorders underlying the cardiomyopathy or other organs affected in planning for treatment in end-stage cardiomyopathy	**2**

Cardiovascular evaluation of the child with features of a syndrome or genetic condition

To be able to carry out cardiac assessment and treatment of children with genetic disorders and syndromes in liaison with the specialist centre team	
Know the main cardiac abnormalities found in common genetic disorders and syndromes including: • Trisomy 21 (Down syndrome) • Trisomy 18 (Edwards Syndrome) • Trisomy 13 (Patau syndrome) • Monosomy XO (Turner syndrome) • Noonan syndrome • Williams syndrome • Alagille syndrome • Marfan syndrome • 22q11 deletion • CHARGE association • VACTERL association • Inherited arrhythmias including channelopathies	**2**
Be aware of the main cardiac abnormalities found in less common genetic disorders and syndromes including: • Storage diseases • Neuromuscular diseases • Mitochondrial cytopathies • Hyperlipidaemias • Inherited Cardiomyopathies	
Know the prognosis of genetic syndromes and their associated cardiac disorders	**1**
Understand the importance and practise of screening for cardiac conditions with a genetic basis	**1**
Be aware of the importance of fetal cardiology review for future pregnancies	**1**
Be able to:	
Recognise the importance of the multidisciplinary team in the management of patients in this group	**1**
Recognise the impact of other features of the genetic disorder or syndrome on cardiac management	**1**
Be willing to discuss the possibility of recurrence of the cardiac disorder in subsequent children whilst recognising the role of the clinical geneticist in expert counselling of parents about recurrence	**2**
Use transthoracic echocardiography to screen, recognise and/or diagnose specific abnormalities in cardiac structure or function related to genetic disorders and syndromes	**2**
Prepare families sensitively for later discussion of wider issues involving genetics when referring to specialist centre for intervention or surgery for congenital heart disease	**2**

Cardiac Evaluation of a Child with Stridor

To be able to carry out preliminary specialist cardiac assessment of children with stridor and know when it is appropriate to refer to the specialist cardiac centre for further evaluation or treatment	
Know:	
The embryology, anatomy and natural history of vascular rings and slings and their association with additional lung pathology	**1**
How to distinguish the cardiac and non-cardiac causes of stridor throughout childhood	**1**
The limitations of transthoracic echocardiography in the identification of vascular rings	**1**
The role and features of vascular rings and slings on CXR, barium swallow, and bronchoscopy	**1**
The role and key features of vascular rings and slings on angiography and MRI	**1**
The role of surgery and main surgical options for release of rings and slings	**1**
Understand the transthoracic echocardiographic findings specific to vascular rings and slings	**2**
Be able to:	
Discuss the main causes, natural history and management of stridor with parents, offering reassurance or referral to the specialist centre as appropriate	**1**
Be aware of the role of thoracic surgeons in children with associated lung abnormalities	**1**
Undertake initial transthoracic echocardiography with the aim of positively identifying the presence of vascular rings and slings to aid discussion and planning with specialist centre	**2**
Select patients who merit referral to specialist cardiac centre for further investigation by advanced echocardiography, bronchoscopy, CT, angiography or MRI	**2**

Cardiac Evaluation of a Child with Systemic Hypertension

To be able to carry out preliminary specialist cardiac assessment of children with hypertension	
Know:	**1**
The physiology of blood pressure control and mechanisms of systemic hypertension	**1**
The methods of single non-invasive and invasive blood pressure evaluation, their pitfalls and limitations and the role of ambulatory blood pressure monitoring	**1**
The references for normal ranges of blood pressure throughout childhood	**1**
The clinical presentations of systemic hypertension including cardiac and extra-cardiac symptoms and signs	**1**
The therapeutic strategies for hypertension, their indications, advantages and disadvantages	**1**
The importance of multidisciplinary team working (e.g. nephrology, ophthalmology, neurology) liaison and the scope of cardiology within this team	**1**
Be able to:	
Perform accurate non-invasive blood pressure measurement	**1**
Identify and monitor the cardiac causes and consequences of systemic hypertension using electrocardiography (ECG) and transthoracic echocardiography	**1**
Refer to other specialists for expert diagnosis and management in cases of systemic hypertension	**1**
Request additional non-cardiovascular investigations appropriately in the investigation of systemic hypertension	**2**

Management of Critically Ill Children with Cardiovascular Compromise

To be able to make an assessment and initiate treatment of children who are critically ill with severe haemodynamic disturbance	
Know:	
Understand the principles of oxygen supply and demand	**1**
Understand the factors controlling cardiac output	**1**
Understand compensatory mechanisms maintaining cardiovascular homeostasis	**1**
Know the common causes of haemodynamic instability during childhood and know how to differentiate sepsis, hypovolaemia, cardiac failure, cardiac tamponade and hypotension secondary to cardiac rhythm disturbances	**1**
Be able to:	
Recognise the clinical signs of low cardiac output and the clinical signs of progression to shock	**1**
Recognise the biochemical markers of low cardiac output	**1**
Use fluid management and inotropic support appropriately to optimise cardiac output and tissue oxygen delivery	**1**
Recognise the need for intensive care support for children with haemodynamic instability and liaise with intensive care colleagues and specialist units as appropriate	**1**
Communicate the findings of the cardiac assessment clearly and logically with colleagues	**1**
Use transthoracic echocardiography to assist in determining the cause of haemodynamic instability	**2**

Prevention and Management of Infective Endocarditis

To be able to carry out preliminary specialist assessment and shared care management of children with infective endocarditis and to be able to provide advice in respect of prevention of endocarditis	
Know:	
The epidemiology, pathophysiology, clinical manifestations, anatomical features, course and prognosis of various types of infective endocarditis	**1**
Which cardiac lesions have the highest risk of endocarditis	**1**
The role of blood cultures, inflammatory markers, transthoracic echocardiography and referral for transoesophageal echocardiography in the diagnosis of infective endocarditis	**1**
The current recommended antibiotic regimes for endocarditis treatment in children	**1**
The national guidance regarding endocarditis prophylaxis	**1**
The indications for referral to specialist centre for consideration of surgical management for patients who have acute valvular insufficiency secondary to endocarditis	**1**
Understand the importance of close cooperation with microbiologists in diagnosing and treating endocarditis	**1**
Be able to:	
Identify the cardiac and extra-cardiac manifestations of endocarditis	**1**
Integrate clinical and laboratory findings to plan appropriate management	**1**
Provide patient education in respect of minimising the risk of endocarditis	**1**
Interpret blood results and recognise transthoracic echocardiographic manifestations of endocarditis and appreciate their importance and limitations in reaching a diagnosis	**2**
Provide support to colleagues and trainees investigating pyrexia of unknown origin	**2**

Cardiovascular Abnormalities in Neonatal Intensive Care

To be able to carry out preliminary specialist assessment and advise on the treatment of cardiovascular problems commonly arising in the context of neonatal intensive care	
Understand the physiology of fetal and transitional circulation	
Know:	
The pathophysiology, clinical manifestations, echocardiographic features and treatment of persistent pulmonary hypertension of the newborn (PPHN)	**1**
The pathophysiology, clinical manifestations and echocardiographic features of patent arterial duct in the preterm child	**1**
The indications and advantages, risks and contraindications of medical and surgical treatment of patent arterial duct in the preterm child	**1**
Be familiar with published neonatal echocardiography standards documents	**1**
Be able to:	
Use transthoracic echocardiography to differentiate PPHN from congenital heart disease, recognising the importance of specialist centre assessment in cases of doubt	**1**
Use transthoracic echocardiography to aid exclusion of duct dependent systemic and pulmonary circulation when assessing an infant with a patent arterial duct prior to referral to the specialist centre	**1**
Understand basic neonatal care and how sepsis, lung disease, neurological problems and genetic issues influence cardiac management	**1**

Identify probable congenital heart disease in premature and low birth weight infants and make an initial management plan, including the likely and most appropriate timing of transfer to specialist cardiac centre	**2**

Cardiovascular Collapse in Infancy

To be able to carry out preliminary specialist assessment and treatment of infants who present with cardiovascular collapse	
Know:	
The physiology of duct dependent systemic and pulmonary circulation	**1**
The natural history, anatomy, physiology and clinical features of cardiac disorders that cause collapse in infancy	**1**
The cardiac causes of cardiovascular collapse and likely diagnoses on the basis of the timing of presentation	**1**
How to distinguish cardiac and non-cardiac causes of cardiovascular collapse	**1**
The indications, contraindications, and side effects of prostaglandin E therapy for duct dependent systemic and pulmonary circulation	**1**
Know the impact of cardiovascular collapse on other organs	**1**
The indications, limitations and risks of non-invasive and invasive investigation of infants that present with collapse	**2**
The ECG, CXR and echocardiographic findings in congenital heart disease presenting with collapse in infancy	**2**
Understand the principles of angiographic and haemodynamic assessment with cardiac catheterisation for infants who present with collapse and congenital heart disease	**2**
Know the role and risks of catheter intervention and surgery in congenital heart presenting with collapse	**2**
Be able to:	
Take a relevant history and perform an appropriate examination	**1**
Interpret ECG, CXR and blood results and appreciate their importance and limitations in reaching a diagnosis	**1**
Initiate prostaglandin E where appropriate and know how to monitor its effect and when to alter the dose administered prior to transfer to SSC	**1**
Recognise and respond appropriately to the urgency of the clinical situation	**1**
Identify cardiovascular collapse and carry out or direct resuscitation, medical treatment including high dependency care, and stabilisation prior to transfer to SSC	**2**
Use echocardiography as an aid to recognising and/or making a provisional diagnosis of abnormalities in cardiac structure or function associated with collapse in infancy	**2**
Understand the difficulties in diagnosing some cardiac abnormalities on echocardiography and to liaise with the SSC or CCC as appropriate.	**2**
Identify where information is incomplete and refer appropriately for to SSC or CCC for further investigation either by non-invasive imaging or cardiac catheterisation .	**2**

Cardiac Failure in Infants and Children

To be able to carry out preliminary specialist assessment and treatment of cardiac failure in infants and children	
Know :	
the physiology of cardiac failure caused by: • Pressure overload • Volume overload • Restriction to inflow • Reduced contractility	**1**
the physiology of pulmonary oedema	**1**
The natural history, anatomy, physiology and clinical features of disorders that cause cardiac failure at different ages, from newborn to adult life	**1**
The causes of cardiac failure and identify likely diagnoses on the basis of the timing of presentation	**1**
How to distinguish cardiac failure from other causes of increased respiratory effort	**1**
The indications, contraindications, action and side-effects of drug treatment for cardiac failure	**1**
The ECG, CXR and key echocardiographic findings in cardiac disorders presenting with cardiac failure	**2**
Understand the principles of angiographic and haemodynamic assessment by cardiac catheterisation for infants and children who present with cardiac failure and congenital heart disease	**2**
The role and risks of catheter intervention and surgery in congenital heart disease presenting with cardiac failure	**2**
Be able to:	
Identify cardiac failure in paediatric patients throughout childhood.	**1**
Take a relevant history and perform an appropriate examination	**1**
Make a provisional anatomical and physiological diagnosis of the cause of cardiac failure on the basis of the clinical information and investigations, prior to referral to the specialist centre	**1**
Optimise nutrition and manage failure to thrive caused by cardiac failure	**1**
Appreciate the role of cardiac nurses and cardiac community nurses in managing chronic cardiac failure	**1**
Interpret ECG, CXR and blood results and appreciate the importance and limitations of these investigations in diagnosing cardiac failure and elucidating its underlying cause	**1**
Use echocardiography to look for and/or provisionally diagnose abnormalities in cardiac structure or function associated with cardiac failure in infants and children prior to timely transfer to SSC or CCC.	**2**
Identify where information is incomplete and refer appropriately to a SSC or CCC for further investigation either by non-invasive imaging or cardiac catheterisation .	**2**
Institute appropriate drug therapy for cardiac failure and monitor its success and complications	**2**

Acyanotic Congenital Heart Disease throughout Childhood

To be able to carry out preliminary specialist assessment and treatment of children with acyanotic congenital heart disease	
Know :	
the principal anatomy, physiology, epidemiology, natural history, associations, and genetic implications of the main acyanotic congenital heart defects including: • Atrial septal defect • Ventricular septal defect • Atrioventricular septal defect • Patent arterial duct • Aortopulmonary septal defect • Pulmonary stenosis • Aortic stenosis • Coarctation of the aorta • Interrupted aortic arch • Hypoplastic left heart syndrome	**1**
The impact of left to right shunts on pulmonary vascular resistance and the physiology of Eisenmenger syndrome	**1**
The nature and timing of clinical presentations and long term complications of the above acyanotic congenital heart defects	**1**
The key ECG, CXR and echocardiographic findings of the main lesions	**1**
The national recommendations regarding the prevention and management of infective endocarditis	**1**
The indications, limitations and risks of non-invasive and invasive investigation	**2**
The principles of angiographic and haemodynamic assessment by cardiac catheterisation	**2**
The range of surgical and catheter intervention treatment options including their main advantages and success rates, disadvantages and complications	**2**
The normal course of postoperative recovery and potential complications after surgery for the main lesions	**2**
Be able to:	
Make a provisional diagnosis and discriminate between acyanotic defects on the basis of presentation, clinical findings, ECG and CXR	**1**
Use transthoracic echocardiography to make a provisional diagnosis of acyanotic defects and to define their main anatomical and physiological characteristics	**2**

Cyanotic Heart Disease in the Newborn Period

To be able to carry out initial preliminary specialist assessment and treatment of cyanotic newborn	
Know :	
The physiology of cyanosis caused by: • Right heart obstruction with right to left shunting • Parallel circulation • Common mixing lesions	**1**
Understand the physiology of duct dependent pulmonary circulation	**1**
The natural history, anatomy, physiology and clinical features of congenital heart disease causing cyanosis in the newborn period	**1**
How to distinguish cardiac and non-cardiac causes of cyanosis in the newborn period	**1**
The indications, limitations and risks non-invasive and invasive investigation in newborns	**1**
The ECG, CXR and echocardiographic findings for the main cyanotic lesions presenting in infancy	**1**
The indications, contraindications, and side effects of prostaglandin E therapy for duct dependent pulmonary circulation	**1**
The role and risks of catheter intervention and surgery in congenital heart disease presenting with cyanosis in the newborn period	**1**
Understand the principles of angiographic and haemodynamic assessment by cardiac catheterisation for neonates who present with cyanosis and congenital heart disease	**2**
Be able to:	
Take a relevant history and perform an appropriate examination	**1**
Interpret ECG, CXR and blood results and appreciate their importance and limitations in reaching a diagnosis	**1**
Make an initial anatomical and physiological diagnosis on the basis of the clinical information and investigations	**1**
Initiate prostaglandin E where appropriate and know how to monitor its effect and when to alter the dose administered	**1**
Use echocardiography to recognise and/or provisionally diagnose major abnormalities in cardiac structure or function associated with cyanosis in the newborn period, and recognise when further specialist assessment is essential	**2**
Identify where information is incomplete and refer appropriately to a SSC or CCC for further non-invasive or invasive imaging.	**2**

Cyanotic Heart Disease beyond the Newborn Period

To be able to carry out preliminary specialist assessment and treatment of children, adolescents and adults with cyanotic congenital heart disease	
Know:	
The principal anatomy, physiology, epidemiology, natural history, associations and genetic implications of the main cyanotic congenital heart defects including:	
• Pulmonary atresia with intact ventricular septum • Pulmonary atresia with ventricular septal defect • Critical pulmonary stenosis	**1**

• Tetralogy of Fallot • Absent pulmonary valve syndrome • Transposition of the great arteries with intact ventricular septum • Transposition of the great arteries with ventricular septal defect • Double outlet right ventricle • Common arterial trunk • Total anomalous pulmonary venous connection • Univentricular atrioventricular connection • Complex congenital heart disease associated with abnormalities of cardiac position and situs	
Know the nature and timing of clinical presentations and long term complications of the above	**1**
The indications, limitations and risks of non-invasive and invasive investigation	**1**
Understand the principles of angiographic and haemodynamic assessment by cardiac catheterisation for patients with cyanotic congenital heart disease	**1**
Know the normal course of postoperative recovery after surgery for each type of cyanotic cardiac defect	**1**
The ECG, CXR and echocardiographic findings in patients with cyanotic congenital heart disease	**1**
The range of surgical and catheter intervention treatment options for cyanotic cardiac defects including their main advantages and success rates, disadvantages and complications	**2**
Be able to:	
Make a provisional diagnosis and discriminate between the various cyanotic defects on the basis of presentation, clinical findings, ECG and CXR	**1**
Provide first line emergency treatment for cyanotic spells and liaise with the specialist centre about further management	**1**
Identify when there is cyanosis combined with cardiac failure and initiate medical treatment when necessary	**1**
Appreciate the concerns and anxiety of parents and other family members	**1**
Liaise with the SSC or CCC for advice and/or evaluation when necessary	**1**
Communicate effectively with the with SSC or CCC for the joint management of patients	**1**
Use transthoracic echocardiography to make an initial diagnosis of cyanotic defects and to define their main anatomical and physiological characteristics	**2**
Recognise the wider management issues in children with complex cyanotic defects or syndromes and cooperate with other specialties	**2**

Cavopulmonary Circulations and Systemic to Pulmonary Shunts

To be able to carry out assessment and ongoing surveillance of children in secondary care who require or have a cavopulmonary circulation and/or a systemic to pulmonary shunt	
Know:	
The physiology of the cavopulmonary circulation and systemic to pulmonary shunts	**1**
The surgical procedures used to create a cavopulmonary circulation	**1**
The likely timing of invasive assessments and operative stages for patients with cavopulmonary circulations	**1**
The complications of cavopulmonary circulations and systemic to pulmonary shunts	**1**

The key anatomical and physiological requirements necessary for a child to tolerate a cavopulmonary circulation	**2**
The key principles of the management of a cavopulmonary circulations in the postoperative period	**2**
Be able to:	
Recognise where there may be a failing cavopulmonary circulation requiring urgent SSC or CCC assessment	**1**
Recognise where there may be a failed or failing systemic to pulmonary shunt requiring urgent SSC or CCC assessment	**1**
Recognise the additional stress on parents when their child cannot undergo corrective surgery	**1**
Recognise the need for close support of the family when the child has to undergo multiple procedures	**1**
Recognise when oxygen saturation are inappropriately low in the setting of a cavopulmonary circulation or systemic to pulmonary shunt	**1**
Make a clinical assessment, including transthoracic echocardiography, to identify key reasons for failure of a cavopulmonary circulation or systemic to pulmonary artery shunt	**2**

Pulmonary Hypertension

To make a provisional diagnosis of pulmonary hypertension, be involved in shared care follow up with the specialist cardiac centre, and understand the key management issues for patients with pulmonary hypertension	
Know:	
The main physiological and anatomical mechanisms associated with pulmonary hypertension	**1**
The congenital heart defects which may lead to or be associated with pulmonary hypertension	**1**
Physical signs of pulmonary hypertension	**1**
Key features of pulmonary hypertension on ECG, CXR and echocardiography	**1**
Understand the significance of pulmonary hypertension, either alone or in the context of associated congenital heart disease	**1**
The range of currently available medical and surgical treatments (including lung transplantation) and their key advantages, limitations, and disadvantages	**1**
Understand the principles of cardiac catheterisation in the diagnosis of pulmonary hypertension	**2**
To understand how to support and counsel parents and patients about severe incurable disease	**2**
Be able to:	
Perform a complete history and physical examination to recognise the presence or evolution of pulmonary hypertension	**1**
Interpret ECG in the diagnosis and monitoring of pulmonary hypertension	**1**
Perform echocardiography in the initial diagnosis of the key features of pulmonary hypertension and to monitor basic progress and response to treatment to assist the dialogue with specialist centre	**2**

Assessment of Children with Cardiac Disease Prior to Non-Cardiac Surgery

To be able to offer local cardiac support during an anaesthetic pre-operative assessment of children with heart disease prior to non-cardiac surgery and either recommend further specialist assessment or liaise with SSC/CCC to offer advise on their fitness and the appropriate location

for such surgery	
Know: The cardiac disorders associated with high risk during general anaesthesia *(for which surgery and any preoperative assessment should be carried out in specialist cardiac centre)*	**1**
The role and limitations of play specialists and psychologists in preparing children for surgery	**1**
Be able to:	
Identify patients who are at increased risk from anaesthesia and recommend when appropriate for anaesthetic to be carried out in setting of SSC/CCC as appropriate	**1**
Select patients who require further investigation by ECG, CXR or echocardiography	**1**
Answer questions from patients and their parents about the impact of their cardiac condition on the safety of anaesthesia and surgery	**1**
Obtain information which would allow determination of the physiology of the cardiac abnormality and make an assessment of the potential cardiac considerations for anaesthetic using ECG, CXR and echocardiography, and seek full discussion with SCC/CCC regarding any conclusions	**2**
Liaise with the anaesthetist and surgeon with clear advice about the relevance of any cardiac condition and ensure that the specialist paediatric cardiologist's advice has been sought prior to consideration of any surgery or anaesthetic in high risk cases	**2**
Liaise with specialist cardiologists to recommend an appropriate fluid regime and how cardiac drugs are to be administered in the perioperative period	**2**

Assessment of Children Prior to Cardiac Surgery

To be able to carry out preliminary specialist assessment of children requiring cardiac surgery and to participate in the planning of cardiac surgery in conjunction with the specialist cardiac unit	
Know:	
Understand the principles of cardiopulmonary bypass and the risks involved	**1**
Understand the risks and benefits of various types of pump and non-pump surgery	**1**
Factors that place a child at increased risk from cardiac surgery	**1**
The benefits and importance of a multi-disciplinary approach toward preoperative assessment	**1**
Understand the role of play specialists and psychologists in preparing children for cardiac surgery	**1**
Be able to:	
Present relevant details of the cardiac condition and the results of investigations to the specialist cardiac unit when making a joint plan regarding the nature and timing of surgical intervention	**1**

Care of Children Following Cardiac Surgery

To be aware of the principles of post-operative intensive care, ward-based care and outpatient care following paediatric cardiac surgery	
Be aware of :	
The postoperative problems caused by cardiopulmonary bypass	**1**
The management of fluid balance, electrolyte balance, coagulation abnormalities and inotropic support	**1**
The particular problems associated with cardiac surgery for the various types of congenital heart defect (see accompanying sections)	**2**
How to manipulate pulmonary vascular resistance and how to prevent and treat pulmonary	**2**

hypertensive crises	
How to assess cardiac output and tissue oxygen delivery	**2**
Be able to:	
Secure arterial access and peripheral venous access	**1**
Recognise rhythm abnormalities, initiate life saving treatment, and seek appropriate specialist advice	**1**
Recognise signs of cerebral damage and seizures and arrange for appropriate investigation and treatment	**1**
Detect when there are markers of sepsis, take appropriate measures to identify the source and select effective antibiotic treatment	**1**
Recognise life threatening cardiac tamponade and carry out emergency pericardial drainage in this situation under supervision of specialist cardiologist, cardiac surgeon, or intensivist	**1**
Counsel parents, in conjunction with the specialist cardiologist or surgeon, about the results of surgery and the child's current status	**2**
Use transthoracic echocardiography if necessary to make an initial evaluation of the results of surgery, assess cardiac function and identify pericardial effusions, pleural effusions, and intracardiac and great vessel thrombus to aid further discussion with tertiary centre	**2**
Be aware of the potential for undiagnosed lesions or residual lesions that may need further specialist cardiological assessment or surgical intervention	**2**

Detection and Management of Fetal Cardiac Abnormalities

To be able to advise on appropriate referral for fetal cardiac evaluation, and to be able to advise parents on the timing and the limitations of antenatal diagnosis of cardiac abnormality	
Know:	
The key indications for a fetal cardiac assessment	**1**
The limitations of fetal echocardiography	**1**
The main associations between fetal cardiac abnormalities and genetic abnormalities	**1**
Understand the importance of non-directive counselling given by the fetal medicine and cardiology team regarding continuation or termination of pregnancy	**1**
The risks of non-specialist counselling and importance of ensuring that families are given optimal information by the fetal medicine or cardiology specialists	**1**
Be able to:	
Appreciate the importance of providing a realistic view of outcome if asked to help parents to make decisions in respect of the pregnancy	**2**
Understand the anxiety and distress of parents presented with a fetal diagnosis of cardiac abnormality	**2**
Appreciate the need for close communication between the fetal medicine team, the obstetric team, the cardiologists, and the PEC	**2**

Adolescent and Adult Congenital Heart Disease

To be able to carry out assessment and treatment of adolescents with congenital heart disease	
Know:	
The natural history of congenital heart disease through to adolescence and adult life	**1**
The problems associated with un-operated congenital heart disease in adolescents	**1**

The long-term sequelae of surgery for congenital heart disease	**1**
Understand the cardiovascular changes in pregnancy and their relevance to patients with congenital heart disease	**1**
The indications for non-invasive and invasive investigation in the adolescent age group	**1**
Understand the importance of offering genetic counselling to adolescents with congenital heart disease	**2**
Understand the implications of operated and un-operated congenital heart disease for contraception and pregnancy	**2**
The common rhythm disturbances in adolescent congenital heart disease and the treatment options	**2**
Be able to:	
Arrange for a smooth transition from the paediatric to the adult congenital service	**1**
Appreciate the worries and concerns of adolescent patients with congenital heart disease	**1**
Appreciate the need to transfer responsibility for the decision making from the parents to the patient	**1**
Be able to counsel adolescents with cardiac disease regarding employment	**1**
Be able to counsel adolescents with cardiac disease regarding lifestyle issues such as healthy eating, exercise, contraception and the effect of smoking, alcohol and drug ingestion.	**1**
Be able to signpost adolescents to appropriate sources of information and support regarding the details and implications of their cardiac condition	**1**
Carry out transthoracic and arrange transoesophageal echocardiography in adolescent patients at the SSC or CCC.	**2**
Contribute to the overall management plan for an adolescent patient in liaison with the specialist cardiac centre and adult services when appropriate	**2**

Paediatric Cardiac and Cardiopulmonary Transplantation

To be aware of when heart or heart-lung transplantation may be indicated and to liaise with tertiary centre to facilitate good pre and post transplant care	
Know:	
Be aware of indications and contraindications for cardiac transplantation	**2**
Be aware of the principles of recipient evaluation	**2**
Be able to:	
Be aware of the ethical and legal issues in respect of donor selection and management and organ procurement	**2**

Section 5 Practical Procedures and Investigations

Lead Electrocardiogram (ECG)

To be able to carry out and interpret the 12 lead ECG throughout childhood	
Know:	
The principles of electrophysiology relating to the production of the ECG and limitations of the ECG and of differing ECG machines	**1**
The standard lead placement for paediatric ECG recording and lead placement for dextrocardia	**1**
Age related changes in ECG wave forms	**1**
How to evaluate rhythm, hypertrophy, ischaemia, injury and infarction on ECG	**1**
The features of ECG produced using epicardial pacing wires	**2**
Be able to:	
Perform a 12 lead ECG with accurate lead placement appropriate to the age of the child	**1**
Interpret ECG in relation to age related changes	**1**
Recognise and interpret abnormal QRS axis, atrial enlargement, normal and abnormal patterns of atrial depolarisation, ventricular hypertrophy, normal and abnormal patterns of ventricular depolarisation, normal and abnormal ventricular repolarisation, bundle branch block, heart block, pre-excitation and tachyarrhythmias on the ECG	**1**

Chest X-Ray

To be able to interpret a CXR to assist diagnosis and assessment of cardiac conditions throughout childhood	
Know:	
The principles and practice of radiation protection	**1**
The classical abnormalities in cardiac silhouette produced by congenital heart defects	**1**
The characteristic CXR appearances of high and low pulmonary blood flow, pulmonary oedema and pulmonary vascular disease with pulmonary hypertension	**1**
Know the limitations of the CXR in diagnosing and assessing congenital heart disease	**1**
Be able to:	
Diagnose abnormalities in cardiac position and identify when great artery arrangement is abnormal on CXR	**1**
Interpret patterns of pulmonary vasculature on CXR	**1**
Recognise lung pathology on CXR	**1**
Use information on the CXR to assist in making an anatomical and physiological diagnosis in congenital heart disease	**1**

Transthoracic Echocardiography

To be able to perform transthoracic echocardiography throughout childhood to diagnose and assess the common forms of congenital and acquired heart disease and recognise where further more expert assessment is essential	
It is recognised that achieving these objectives to a full level of competence will not occur during a single year. It is essential that this competency is formally assessed during training across the range of structural and functional heart conditions. (Standards for this assessment are detailed in Appendix 1, Section 4.3). Focussed continued professional development will be required and formal accreditation is strongly recommended. Currently, the only individual certification pathway and revalidation pathway is via the European route under the auspices of the European Association of Echocardiography and endorsed by the Association of European paediatric cardiology (AEPC) and European society of cardiology (ESC). Ongoing regular personal audit and peer review of practise throughout the doctor's career will be necessary. It is essential that an awareness of personal limitations and confidence to seek review of findings is maintained and that the implications of a failure to recognise important abnormality are appreciated. *Trainees and practitioners should recognise that the performance of non-contributory echocardiography should never lead to a delay in obtaining specialist advice or arranging specialist transfer when indicated.*	
Know and understand:	
The physics of 2 dimensional echocardiography, colour Doppler and spectral Doppler	**1**
The factors determining image quality and resolution	**1**
The function of the controls on machines used for echocardiography and Doppler	**1**
The key echocardiographic characteristics of the most commonly encountered congenital heart defects and how to assess the physiology of shunting defects	**1**
Be aware of the limitations of echocardiography and Doppler	**1**
How to assess valve stenosis and regurgitation	**1**
The commonly used indices of ventricular function	**1**
How to relate the measurements of cardiac structures to body size by indexation or z-scores	**1**
Understand the role of advanced echocardiography techniques (e.g. 3D and 4D, tissue tracking)	**2**
Understand the practice, indications and limitations of echo-contrast studies	**2**
Be able to:	
Label and store echocardiography studies using appropriate long term storage media	**1**
Manipulate the image to obtain optimal image quality	**1**
Obtain all appropriate views during an echocardiographic examination and produce a structured record of the examination	**1**
Transfer images via telecardiology links for review with cardiologists from the specialist cardiac unit	**1**
Have appropriate self-confidence and recognise personal limitations in echocardiography skills	**1**

Perform echocardiography to assist the specialist cardiologist during visiting clinics	**1**
Schedule cases for review and audit of echocardiographic assessment	**1**
Develop and work within guidance regarding the range of appropriate cases agreed with the specialist centre	
Interpret the significance and reliability of the information obtained by echocardiography	**2**
Demonstrate ability to work with and share expertise mutually with echocardiography technicians	**2**

Ambulatory ECG and External Cardiac Loop Recorder

To be able to request and interpret the results of ambulatory ECG and external cardiac loop recording appropriately in the diagnosis and assessment of children with cardiac conditions	
Know:	
The indications for an ambulatory ECG and external cardiac loop recorder	**1**
The normal range of findings on a paediatric 24 hour ECG	**1**
Understand the limitations of these non-invasive ECG investigations	**1**
Be able to:	
Scan the results of these investigations select appropriate highlights and produce an accurate report	**1**
Interpret the results in the clinical context	**2**

Ambulatory Blood Pressure

To be able to request and interpret the results of ambulatory blood pressure monitoring appropriately in the diagnosis, assessment and surveillance of children with cardiac conditions	
Know:	
The indications for an ambulatory blood pressure monitoring	**1**
The normal range of blood pressure and variation throughout the daily cycle	**1**
Understand the limitations of ambulatory blood pressure monitoring	**1**
Be able to:	
Interpret the results in the clinical context	**2**

Exercise Tests

To be able to carry out and interpret exercise tests appropriately in the diagnosis and assessment of children with cardiac conditions	
Know:	
The physiology of cardiovascular response to exercise	**1**
The contraindications and age limitations to exercise testing in children	**1**
The methodology of a treadmill (exercise) test	**1**
The normal heart rate and blood pressure responses to exercise	**1**
Be aware of the sensitivity, specificity and predictive accuracy of exercise ECG	**1**
Understand the limitations of exercise testing in children	**1**
Be able to:	
Interpret changes in the ECG during the exercise test	**2**

Interpret changes in heart rate, blood pressure and oxygen saturation during an exercise test	**2**

ECG with Adenosine Challenge

To be able to safely carry out and interpret an ECG taken during an adenosine challenge	
Knowledge and Understanding	
Know the indications for and possible interpretations of adenosine challenges during tachycardias	**1**
Be able to:	
Acquire an ECG during an adenosine challenge with appropriate monitoring and resuscitation equipment available	**1**
Provide explanation to patients and parents about the effect of adenosine administration	**1**
Diagnose the mechanism of an arrhythmia based on the result of the adenosine challenge	**2**

Tilt Table Testing

To understand the role, principles, practise, and limitations of tilt table testing in patients with syncope	
Know:	
The physiological principles of tilt table testing	**1**
The indications for tilt table testing	**1**
The methodology of tilt table testing	**1**
The risk and limitations, sensitivity and specificity of tilt table testing	**2**
Be able to:	
Refer for tilt table testing appropriately and with a clear objective	**2**
Make an initial interpretation of the findings of a tilt table test	**2**

DC Cardioversion

To be able to perform emergency DC cardioversion, and understand the principles and practise of elective DC cardioversion	
Know:	
The indications for synchronised and unsynchronised DC cardioversion	**1**
The safety precautions necessary for the protection of patients and staff during DC cardioversion	**1**
Be able to:	
Operate the available equipment for DC cardioversion	**1**
Select an appropriate energy for DC cardioversion for different arrhythmias at different ages	**1**
Carry out DC cardioversion as part of emergency resuscitation	**1**
Appreciate the possibility of underlying abnormalities in cardiac rhythm, structure or function causing abrupt haemodynamic deterioration after cardioversion and make appropriate preparations for resuscitation	**1**

Cardiac Pacing

To understand the principles of temporary and permanent pacing and pacemaker monitoring

Know:	
Basic electrophysiology and cardiac anatomy relevant to pacing	**1**
The indications for temporary and permanent pacing	**1**
The problems, limitations, and complications of pacing and pacemaker dysfunction	**1**
About the potential psychosocial impact of requiring a pacemaker on children and their families	**1**
The main types of pacing, the nomenclature and key features of the surface ECG	**2**
The principles of monitoring, interrogating and programming pacemakers	**2**
Be able to:	
Be able to recognise appropriate and non-functioning pacing on the surface ECG	**1**

Pericardiocentesis

To understand the practice and technique of pericardiocentesis, and to be able pericardiocentesis in the emergency setting	
Knowledge and Understanding	
Know the indications for elective and emergency pericardiocentesis	**1**
Know the risks of pericardiocentesis	**1**
Be able to:	
Perform emergency lifesaving pericardiocentesis by the safest and most effective approach when necessary in a life threatening situation as also taught through mandatory APLS training	**2**

Balloon Atrial Septostomy

To understand the principles and practice of balloon atrial septostomy	
Know:	
The indications for balloon atrial septostomy	**1**
The risks of balloon atrial septostomy	**1**
Be able to:	
To appreciate the importance of team working during balloon septostomy and to recognise that it must only be carried out by a trained and competent cardiologist	**1**
Counsel the parents in respect of the risks and benefits of the procedure	**2**
Perform transthoracic echocardiography when necessary to assist the interventional cardiologist performing balloon atrial septostomy	**2**
Supervise the care of an infant after balloon atrial septostomy	**2**

Transoesophageal Echocardiography

To understand the principles and practice of transoesophageal echocardiography	
Know:	
The indications for and risks of transoesophageal echocardiography	**1**
Be able to:	
Be able to recognise when transoesophageal echocardiography will provide useful additional information	**1**

Cardiac Catheterisation

To understand the practice and principles of interpreting diagnostic cardiac catheterisation in children and adults with cardiac disease, and know about the key techniques of interventional catheterisation	
Know:	
The indications for diagnostic cardiac catheterisation	**1**
The indications for and limitation of the following common catheter interventions: • Occlusion of patent arterial duct • Balloon pulmonary valvoplasty • Balloon aortic valvoplasty • Pulmonary artery angioplasty • Re-coarctation angioplasty • Occlusion of atrial and ventricular septal defects • Stent insertion	**1**
The key principles of electrophysiological catheter studies and interventions	**1**
The principles of the interpretation of haemodynamic data	**2**
The basic principles of less common interventions	**2**
Be able to:	
Recognise when cardiac catheterisation may be useful and refer to the specialist cardiac centre for their assessment of the potential value of this procedure	**2**

Cardiac MRI and Thoracic CT

To understand the role and practice of Cardiac MRI and CT in assessing children with cardiac conditions	
Know:	
Indications and contraindications for cardiac MRI and CT of the thorax	**1**
The basics of MR safety	**1**
The information that can be obtained by MRI including: (i) Static and dynamic imaging of the heart and great vessels (ii) Functional information such as flow, velocity, perfusion and ventricular function	**1**
The limitations of non-invasive imaging	**1**
The fundamentals and limitations of MR image acquisition	**2**
Be able to:	
Interpret basic MR and CT images of the heart and great vessels, recognising when expert help is required	**2**
Interpret cardiac MR reports and their application to clinical management	**2**

Appendix 1

Paediatric Guidance Checklist

These standards were derived to assist in the assessment of the paediatric training standards in your deanery.

Specialty: Special Study Module in Paediatric Cardiology for Paediatricians

The Programme (which may consist of more than one training post within a Specialist Surgical Centre or Children's Cardiology Centre) should provide:

1. Supervision	**✓/✗**
1.1 An educational supervisor who is a consultant paediatric cardiologist and is trained in assessment and appraisal.	
1.2 An educational supervisor who provides average 1PA per 4 trainees per week of educational supervision.	
1.3 Evidence that the assessment strategy is being delivered.	
1.4 Trainers receive appropriate training on the delivery of the assessment strategy.	
1.5 There is appropriate supervision to ensure patient safety.	

2. Other Personnel	
2.1 A minimum of 1 paediatric cardiology consultant per half a million population served to support and supervise training and practice.	
2.2 Nursing staff with appropriate training in caring for a child with congenital and acquired heart disease.	
2.3 More than one ST4 -8 in the paediatric cardiology department, who may be either a general paediatric trainee or paediatric cardiology trainees.	
2.4 A consultant should be readily available for expert assistance in the event of unexpected cardiovascular collapse.	
2.5 pharmacist, physiotherapist, dietician, psychologist.	
2.6 There should be close links and opportunities to interact with General Paediatricians with Expertise in Cardiology working in allied District Children's Cardiology Services.	

3. Service requirements and facilities	
3.1 ***Specialty specific requirements of subspecialty department:*** Training centres must be designated Specialist Surgical Centre or Children's Cardiology Centre.	
3.2 ***Specialty specific requirements of related clinical departments that are involved in the delivery of the curriculum:*** There should be close links with the following departments: Cardiac liaison nursing department, Emergency department, Neonatal intensive care unit, Paediatric intensive care unit, Cardiothoracic surgery, Fetal medicine service, Adult congenital heart disease service (with particular reference to transition and long term complications), Paediatric subspecialities (including Neurology, Respiratory, Nephrology, Haematology, Immunology), Clinical genetics.	
3.3 ***Specialty specific requirements of service departments relevant to the delivery of curriculum (e.g. investigations, surgery, anaesthesia)*** Non-invasive and invasive cardiology investigation department, Cardiothoracic radiology, Paediatric cardiothoracic anaesthesia, Specialist pharmacy, Specialist dietetic department, Specialist psychology service.	
3.4 ***Specialty specific requirements of clinical networks*** Evidence of working partnership with Paediatricians with Expertise in Cardiology	

within District Children's Cardiology Service. Training centres should satisfy any nationally agreed network standards. Trainees should be encouraged to participate in outreach activities including the development of network guidelines.	

4. Educational activities and training	
4.1 ***Specialty specific clinical exposure required to provide sufficient learning opportunities:*** Attendance at fetal cardiology assessments. Observation of antenatal counselling regarding congenital heart disease. Resuscitation and stabilisation of collapsed patients with heart disease. Pre and post operative assessment of cardiac surgical patients. Outpatient surveillance of patients with established heart disease. Outpatient assessment of patients with potential heart disease. Inpatient and outpatient assessment of patients with potential cardiac problem(s) in association with other condition. Experience of transitional planning and arrangements for adolescents and young adults with congenital heart disease.	
4.2 ***Specialty specific requirements for structured training opportunities to include courses:*** It is recommended that trainees seek formal training courses including the following areas: • Transthoracic echocardiography • Electrocardiography and arrhythmia management • Cardiac morphology It is strongly recommended that trainees pursue formal echocardiography accreditation (e.g through the European Association of Echocardiography) during their level 3 training (see section 4.3 below). Trainees should recognise that they may be working alongside colleagues who are training to become Paediatric Cardiologists with different expected training outcomes across theoretical and practical aspects of the curricula.	
4.3 ***Specialty specific requirements for other experiential learning (excluding clinics and ward rounds)***	
a) Echocardiography • Trainees should keep a personal log book of all echocardiograms performed throughout level 3 training which should be available for their educational supervisor's review. • Trainees and their supervisors should maintain awareness regarding any newly published national guidance regarding echocardiography in children or neonates and work within such guidance as appropriate. • It is strongly recommended that trainees pursue formal echocardiography accreditation (e.g. through the European Association of Echocardiography) during their level 3 training • Trainees should perform echocardiograpy DOPS in addition to the number of DOPS expected within the level 3 training framework. • An average of 1 additional echocardiography DOPS per month of training should be completed, and no less than 10 DOPS per year (whole time equivalent). These should be used as a tool for directing echocardiography learning and monitoring successful progress in this area. • By the end of the training post these echocardiography DOPS should include at least one of each the following 9 groups of patients: o full echocardiography data set of 1 patient with a normal heart o 1 neonate with congenital heart disease o 1 infant with cyanotic heart disease prior to intervention	

○ 1 patient with valvular heart disease ○ 1 patient with inflammatory heart disease ○ 1 patient with myocardial dysfunction ○ 1 patient with syndrome or genetic condition requiring cardiac screening ○ 1 patient with post operative echocardiography assessment ○ 1 patient with cavopulmonary connection • Whilst recognising that the number of echocardiograms performed may not reflect competence in this area, trainees should log all echocardiographic studies performed and aim to complete 200-250 studies during a 12 month period. b) Other areas of experiential learning opportunity • Interpretation of 24 hour ECG and event recordings • Exercise test supervision and interpretation • Tilt test supervision and interpretation • Attendance at pacing assessments • Attendance of catheter laboratory (desirable) • Attendance of cardiac surgery (desirable)	

5. Working patterns	
For both PICU and DGH or tertiary centre HDU components	
5.1 Safe cover arrangements for paediatric cardiology department out of hours in line with RCPCH guidance.	
5.2 Evidence of compliance with existing employment rules to working time.	
5.3 Working intensity and pattern that is appropriate for learning.	
5.4 Access to sub-specialty training time which allows achievement of competences throughout the programme.	
5.5 This post forms part of a complete paediatric training programme which provides a minimum of 5 years of acute clinical experience, including out of hours duties.	

6. Specific Post requirements	
For the total programme	
6.1 It is recommended that a minimum of 12 months working within tertiary specialist paediatric cardiology units. Either 12 months in a designated Specialist Surgical Centre exclusively or 12 months divided between a Specialist Surgical Centre and a Children's Cardiology centre.	
6.2 In addition to the above (6.1) it is recommended that trainees maintain their interest in paediatric cardiology patients throughout level 3 training. This may be achieved by focussed practice alongside practicing Paediatricians/Neonatologists with expertise in cardiology, and through maintained educational links with specialist units.	

7. Enabled to learn new skills, necessary skills and curriculum coverage (specialty specific) *This section can be used to highlight marker conditions to which trainee should be exposed or the numbers of cases/procedures that trainee will be expected to see/do. Ensure that it is clear whether any numbers are for whole training programme or per annum*	
7.1 ***Specialty specific marker conditions trainee should be exposed to:*** refer to Section 4 of A Framework of Competences for the Level 3 Training Module Special Expertise in Paediatric Cardiology.	
7.2 ***Specialty specific skills/procedures trainee needs to complete:*** refer to Section 5 of A Framework of Competences for the Level 3 Training Module Special Expertise in Paediatric Cardiology.	

8. Access to clinics and ward rounds and long term care of patients	
8.1 ***Specialty specific numbers and types of clinics expected to attend (including outreach clinics:*** Regular participation in supervised clinics including new and review cases.	
8.2 ***Specialty specific combined clinics expected to attend:*** Attendance at outreach clinics to District Children's Cardiology services is not expected during the period of training within the specialist centre, but is strongly encouraged during the remainder of level 3 training.	
8.3 ***Specialty specific ward rounds consultant led and independent per week:*** At least two consultant led wards round each week. Opportunities for trainee to lead planned ward rounds with indirect and direct consultant supervision.	
8.4 ***Specialty specific involvement in transitional care:*** Transition clinics for young people with congenital heart disease.	
8.5 opportunity to participate in outreach activities including the development of network guidelines.	

9. Meetings	
9.1 ***Specialty specific number and types of MDT meetings expected to be exposed to:*** • Regular attendance (at least once weekly) and evidence of participation in combined cardiac surgery and cardiology MDT meetings (including reviews of catheter studies, radiology, electrophysiology, and echocardiography as appropriate). • Cardiac surgical mortality and morbidity meetings. • Critical incident meetings.	
9.2 ***Specialty specific multi-professional meetings expected to be exposed to:*** • Pre-discharge planning meetings for children with complex needs. • Genetics and fetal medicine review meetings.	
9.3 ***Specialty specific other meetings:*** Whilst optional, it is recommended that trainees become members of the RCPCH Paediatricians with Expertise in Cardiology Specialist Interest Group (PECSIG) and British Congenital Cardiac Association (BCCA) and attend the annual meetings of these groups.	

10. Clinical audit	
10.1 Evidence of trainees participation in clinical governance (at least 1 full audit/year and attendance at critical incident meetings).	
10.2 Evidence of trainees participation in clinical guideline development with particular emphasis on guidelines relating to District Children's Cardiology Services.	
10.3 Training units should participate in national data collection systems.	

11. Teaching appraising and assessing	
11.1 Opportunities for formal and informal teaching.	
11.2 For senior trainees: opportunities for involvement of assessment of others.	
11.3 For senior trainees: opportunity to be involved in the appraisal of others.	

12. Research	
Opportunities for participation in relevant and achievable research are encouraged.	

13. Management	
13.1 Opportunities to be involved in management e.g. participation in management meetings and projects.	

13.2 Opportunities to be involved in the planning and delivery of departmental teaching programme, journal club, local and network meetings, network audit and guidelines.	

X-ref	Comments
	Many of the terms used and standards listed are consistent with, or refer to, the 2011 Safe and Sustainable vision of Children's Congenital Heart Services in England as published at the time of preparation, and may therefore be subject to change.