

Guidelines
For
Competency Based Training Programme
In
DNB - PEDIATRIC CARDIOLOGY



NATIONAL BOARD OF EXAMINATIONS

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INTRODUCTION

Specialty training in Paediatric Cardiology consists of core and higher specialty training. Core training provides physicians with: the ability to investigate, treat and diagnose patients with acute and chronic medical symptoms; and with high quality review skills for managing inpatients and outpatients. Higher specialty training then builds on these core skills to develop the specific competencies required to practice independently as a consultant Paediatric Cardiologist.

The most important function of the specialist-training programme is to educate individuals who will become consultants capable of providing the highest standard of service to children with cardiac disorders and adolescents and adults with congenital heart disease.

The educational process set out in this curriculum aims to develop positive attitudes to lifelong learning and aims to equip the trainee to adapt to the changing expectations of society as well as to technological advances, with clear goals for achievement of a sound knowledge base, appropriate attitudes and achievement of competencies as well as appropriate methods of learning and assessment throughout the programme.

Additionally, it is important for the trainee to become aware of the challenges faced at a national level in terms of disease burden and resources. Important adaptations are required to practice the specialty in our country given the resource constraints as well as challenges relating to our unique patient population.

PROGRAMME OBJECTIVES

The education programme in paediatric cardiology aims to produce physicians who:

- Address all aspects of the healthcare needs of patients and their families
- Communicate effectively with children, families, and colleagues
- Are able to coordinate effectively the work of the paediatric cardiology team
- Manage time and resources to the benefit of themselves, their patients and their colleagues .
- Are able to operate as safe independent practitioners whilst recognizing the limitation of their own expertise and the obligation to seek assistance of colleagues where appropriate Have acquired and developed team working and leadership skills
- Work effectively with other health care professionals
- Are able to teach other physicians and health care professionals
- Will be honest and objective when assessing the performance of those they have supervised and trained
- Develop clinical practice which is based on an analysis of relevant clinical research and have an understanding of research methodology
- Are aware of current thinking about ethical and legal issues
- Can take advantage of information technology to enhance all aspects of patient care
- Recognize specific challenges faced by children with heart disease at a national level and work to partner with government in achieving the national ideal of ensuring access to pediatric cardiac care to all affected children.
- Maintain the highest standard in their professional field and show themselves able to respond constructively to assessments and appraisals of professional competence and performance .

- Are able to identify and take responsibility for their own educational needs and the attainment of these needs . Are aware of procedures and able to take action when things go wrong, both in their own practice and in that of others
- Work effectively and efficiently in health care organization
- Are able to apply the knowledge of biological and behavioral sciences in clinical practice
- Apply appropriate knowledge and skill in the diagnosis and management of children with cardiovascular disorders and adults with congenital heart disease
- Are competent to perform the core investigations required for the evaluation of children with cardiovascular disorders and adults with congenital heart disease.
- Can develop management plans for the whole patient and maintain knowledge of other areas of paediatrics and adult medicine which impinge on the specialty of paediatric cardiology.

By the end of specialist training the trainee should have developed competence in the following:

- Good clinical care
- History, examination, investigations, treatment, note keeping and correspondence
- Managing chronic disease
- Time management and decision making
- Communication skills
- Maintaining good medical practice
- Maintaining Trust
- Professional behaviour
- Ethics and legal issues
- Patient education and disease prevention

- Working with colleagues
- Teamwork and leadership skills
- Teaching and educational supervision
- Research
- Clinical governance
- Information use and management
- Cross-specialty skills
- Admissions and discharges
- Discharge planning
- Resuscitation
- Nutrition

Clinical Learning Objectives By the end of the education programme the trainee is expected to manage the following clinical problems:

- Cardiovascular collapse in infancy
- Cardiac failure in infants and children
- Cyanosis in the newborn period
- Cyanosis beyond the newborn period
- Evaluation of the child with a cardiac murmur
- Evaluation of children and adolescents with chest pain, palpitations, presyncope or syncope Patients with acyanotic congenital heart disease
- Left to right shunts
- Duct dependent systemic circulation
- Obstructive left heart lesions
- Acyanotic obstructive right heart lesion
- Patients with cyanotic congenital heart disease
- Duct dependent pulmonary circulation
- Transposition of the great arteries
- Cyanotic congenital heart disease with high pulmonary flow
- Complex cyanotic congenital heart disease Pulmonary hypertension

- Fontan circulation
- Inflammatory cardiovascular disease including Kawasaki Disease
- Rheumatic Heart Disease
- Cardiomyopathy and myocarditis
- Prevention and management of infective endocarditis
- Cardiovascular abnormalities in neonatal intensive care
- Cardiovascular evaluation of children with genetic disorders and syndromes
- Cardiac evaluation of the child with stridor
- Detection and management of fetal cardiac abnormalities
- Adolescent and adult congenital heart disease
- Arrhythmias
- Nutrition and growth in congenital heart disease
- Assessment of children prior to cardiac surgery
- Care of children following cardiac surgery
- Assessment of children with cardiac disease prior to non-cardiac surgery
- Management of critically ill children with cardiovascular compromise

ELIGIBILITY CRITERIA FOR ADMISSIONS TO THE PROGRAMME

(A) DNB Pediatric Cardiology Course:

1. Any medical graduate with ***DNB/MD in Pediatrics*** qualification, who has qualified the ***Entrance Examination*** conducted by NBE and fulfill the eligibility criteria for admission to DNB ***Super Specialty*** courses at various NBE accredited Medical Colleges/ institutions/Hospitals in India is eligible to participate in the Centralized counseling for allocation of DNB **Pediatric Cardiology** seats purely on merit cum choice basis.
2. Admission to 3 years post MBBS DNB **Pediatric Cardiology** course is only through ***Entrance Examination*** conducted by NBE and Centralized Merit Based Counseling conducted by National Board of Examination as per prescribed guidelines.

Duration of Course: 3 Years

Every candidate admitted to the training programme shall pursue a regular course of study (on whole time basis) in the concerned recognized institution under the guidance of recognized post graduate teacher for assigned period of the course.

TEACHING AND TRAINING ACTIVITIES

The fundamental components of the teaching programme should include:

1. Case presentations & discussion- once a week
2. Seminar – Once a week
3. Journal club- Once a week
4. Grand round presentation (by rotation departments and subspecialties)- once a week
5. Faculty lecture teaching- once a month
6. Clinical Audit-Once a Month
7. A poster and have one oral presentation at least once during their training period in a recognized conference.

The rounds should include bedside sessions, file rounds & documentation of case history and examination, progress notes, round discussions, investigations and management plan) interesting and difficult case unit discussions.

The training program would focus on knowledge, skills and attitudes (behavior), all essential components of education. It is being divided into theoretical, clinical and practical in all aspects of the delivery of the rehabilitative care, including methodology of research and teaching.

Theoretical: The theoretical knowledge would be imparted to the candidates through discussions, journal clubs, symposia and seminars. The students are exposed to recent advances through discussions in journal clubs. These are considered necessary in view of an inadequate exposure to the subject in the undergraduate curriculum.

Symposia: Trainees would be required to present a minimum of 20 topics based on the curriculum in a period of three years to the combined class of teachers and students. A free discussion would be encouraged in these symposia. The topics of the symposia would be given to the trainees with the dates for presentation.

Clinical: The trainee would be attached to a faculty member to be able to pick up methods of history taking, examination, prescription writing and management in rehabilitation practice.

Bedside: The trainee would work up cases, learn management of cases by discussion with faculty of the department.

Journal Clubs: This would be a weekly academic exercise. A list of suggested Journals is given towards the end of this document. The candidate would summarize and discuss the scientific article critically. A faculty member will suggest the article and moderate the discussion, with participation by other faculty members and resident doctors. The contributions made by the article in furtherance of the scientific knowledge and limitations, if any, will be highlighted.

Research: The student would carry out the research project and write a thesis/ dissertation in accordance with NBE guidelines. He/ she would also be given exposure to partake in the research projects going on in the departments to learn their planning, methodology and execution so as to learn various aspects of research.

SYLLABUS

Cardiology

I. Pediatric Cardiovascular Epidemiology:

- Disease burden and health system challenges associated with pediatric heart disease in India
- Relative importance of pediatric heart disease in the context of other pediatric health priorities

A detailed study of available literature published from the country on:

Congenital Heart Disease

Rheumatic Heart Disease

Childhood obesity and lifestyle related heart disease

II. Cardiopulmonary Structure, Development, and Function

- Cardiovascular anatomy and ultrastructure
- Gross cardiovascular anatomy. Understand the principles of segmental anatomy
- Know the normal anatomy of the systemic veins and important variations
- Know the normal anatomy of the atria, atrial septum, appendages, and relationship to thoracic structures
- Know the anatomic features of the atrioventricular valves and atrioventricular orientation (concordance/discordance)
- Know the normal anatomical features of the right ventricle, left ventricle, and the inter-ventricular septum, and ventriculo-arterial orientation (concordance/discordance)
- Know the anatomic features of semilunar valves, including spatial relationships to each other and the ventricular outlets
- Know the anatomical features of the pulmonary arteries, pulmonary vasculature and orientation to thoracic structures (eg, bronchi)
- Know the normal structure and anatomic relationships of pulmonary veins

- Know the normal anatomic features of the coronary arteries
- Know the normal anatomy of the aorta and its orientation to thoracic structures
- Know the normal anatomy of the systemic arteries and important variations
- Understand the relationship between the left recurrent laryngeal nerve and structures within the thorax

2 Ultrastructure

A. Know the ultrastructure of cardiac myocyte along with developmental aspects of the myofibrils, contractile proteins, transverse tubular system, sarcoplasmic reticulum, intercalated disc, nucleus and perinuclear region, mitochondria, and glycogen stores

B. Normal embryology and development of myocardial structure and function

- Know the important components (tissues) of the primitive cardiac tube and the origins of cardiac segments including origin of the primary and secondary heart fields
- Understand looping of the primitive cardiac tube under normal and abnormal conditions
- Know the normal development of the peripheral vasculature
- Describe normal embryologic sequence in the development of pulmonary veins, including the fate of the common pulmonary vein
- Know the normal development of the bulbus cordis and truncus arteriosus
- Know the embryologic basis for atrioventricular connections
- Know the development of the six aortic arches (eg, sequence, timing, regressions)
- Know the normal development of the various cardiovascular structures (eg, semilunar valves, aortic pulmonary septum, division of truncus)

- Understand the contribution of neural crest tissue to normal cono - truncal development
- Understand the molecular regulation of cardiac determination and differentiation
- Identify the molecular pathways that determine visceral situs
- Know the origins of the epicardium and its importance for coronary, valvar, and fibrous development of the heart
- Know the normal development of the conduction system
- Know the normal developmental sequence of the pulmonary vasculature
- Know the normal developmental sequence of the coronary vasculature

C. Cardiovascular physiology

1. Embryo and fetus

- Know the distribution of cardiac output to the various circulations during normal and abnormal conditions (eg, pulmonary, coronary, central nervous system, ventricular, peripheral vascular beds, placenta)
- Understand how blood flow patterns in cardiovascular structures, including fetal structures, may be influenced by congenital anomalies
- Understand regulation of circulation in the embryo and fetus
- Understand the fetal circulation and its clinical correlates with findings on fetal echocardiography

2. Postnatal circulation

- Understand the physiologic aspects of postnatal heart rate, preload effects, afterload effects, and contractility, and how these factors modulate cardiac output

- Know the postnatal changes in pulmonary and systemic circulations after birth and how they may be influenced by congenital defects (eg, left-to-right shunts, hypoxemia, obstructive lesions)

3. Cardiac mechanics

- Understand the interaction of contractile and regulatory protein in determining sarcomere function
- Understand the role of calcium ions in the contractile process and dynamics of calcium ion movement/storage
- Understand the process of excitation-contraction coupling
- Understand the concepts and variation of length-tension relationships
- Understand ventricular pressure-volume function loops
- Understand the concept of inter-ventricular interaction
- Understand the role of neural-humoral factors on control of the cardiovascular system
- Understand the role of the thyroid in modulating control of the cardiovascular system
- Understand the role of baroreceptors in control of the cardiovascular system
- Understand the role of chemoreceptors in control of the cardiovascular system
- Understand cellular responses and their interactions with drugs, blood gases, and pH
- Know the molecular events occurring during the cardiac cycle
- Understand the role of the pericardium on impairment of cardiac function

- Understand myocardial metabolism and the impact of hormonal influences, hypoxia, ischemia, and age
- Know how hemodynamic loads affect myocardial gene expression
- Recognize the acute effects and compensatory responses of ventricular dilatation and hypertrophy on cardiac function
- Understand the atrial contribution of ventricular function
- Know the age-related differences in function of sarcolemma and sarcoplasmic reticulum
- Know the effects of acidemia and hypoxemia on contractility
- Recognize factors involved in the myocardial oxygen supply-demand ratio
- Know how hemodynamic loads affect vascular gene expression
- Understand cardiac receptor function and its response to drugs, blood gases, and pH
- Understand the determinants of contractions of isolated cardiac myocytes and papillary muscle

4. Vascular physiology

- Understand the concept of auto regulation of regional blood flow, including age-related differences
- Know the role of inflammatory mediators and of endothelium in control of regional circulation
- Understand the mechanisms that regulate coronary circulation, including exercise and hypoxemia
- Understand the mechanisms that regulate cerebral circulation, including pH, PCO₂, PO₂, and perfusion
- Understand the influence of pH, PO₂, and PCO₂ on pulmonary circulation
- Understand the role of endothelium on pulmonary circulation

- Understand the mechanisms involved in vasodilation in pulmonary and systemic vascular beds
- Identify the factors influencing tone in the pulmonary vascular bed
- Understand how vascular smooth muscle is maintained in a dilated state
- Understand the Poiseuille equation and the effect of changing the caliber of the resistance vessels
- Know the effects of asphyxia on regional circulatory functions, particularly heart, brain, kidneys, and lung
- Know the effects of changes in renal blood flow on renal function and body fluids
- Understand the mechanisms that regulate skeletal muscle blood flow during exercise
- .Conduction system, including electrophysiology

5. Developmental aspects

- Recognize the age-dependent nature of structure and function of the conduction system

6 . Anatomic aspects

- Know anatomic basis and features of the conduction system
- Know the conduction system abnormalities associated with cardiac anomalies

7. Electrophysiologic aspects

- Understand the structure and function of ion channels in myocardial tissue

- Understand the components of the myocardial cell action potential
- Understand the ionic basis of cardiac automaticity
- Know the electrophysiologic characteristics of the atrial, atrioventricular, and ventricular conduction system

8. Respiratory physiology and ventilation

A Structure

- Understand the age-related (including prematurity) effects on airway physiology, including airway resistance and ventilation pattern
- Recognize the effects of upper airway obstruction on cardiopulmonary physiology
- Recognize effects of large airway obstruction on cardiopulmonary physiology
- Recognize effects of cardiomegaly and pulmonary vascular anatomy on large airway function
- Know the pathologic changes that occur in the small airways in various cardiopulmonary conditions
- Recognize potential effects of cardiomegaly and pulmonary vasculature on small airway function
- Know the pathologic changes that occur in the alveoli in various cardiopulmonary conditions, including congestive heart failure and alterations in pulmonary blood flow

B. Ventilation

- Identify and know importance of variations in pulmonary pressure-volume relationships
- Understand the effects of FIO₂ on nitrogen clearance, regional blood flow, and arterial blood gas tensions

- Know the importance of normal lung inflation and deflation on cardiovascular physiology
- Recognize the influence of cardiovascular disease on lung volume, tidal volume, and respiratory rate

C. Oxygen delivery

- Understand the determinants of gas transfer from the airway to arterial blood
- Know factors influencing the amount of dissolved oxygen in blood
- Understand the differences between adult and fetal hemoglobin
- Understand the effects of a change in arterial oxygen tension in the oxy-hemoglobin dissociation curve, and mixed venous oxygen content
- Apply the principles of ventilation-perfusion balance and mismatch in the evaluation of a patient with cardiovascular disease

D. Acid-base balance

- Know how to recognize acid-base abnormalities, including respiratory acidosis and alkalosis and metabolic acidosis and alkalosis
- Identify the causes of acid-base abnormalities, including respiratory acidosis and alkalosis and metabolic acidosis and alkalosis
- Know methods for correction of acid-base abnormalities, including respiratory alkalosis and acidosis and metabolic acidosis and alkalosis

E. Blood gas exchange

- Understand the effects of ischemia on O₂ and CO₂ exchange between blood and tissue
- Understand the effects of pH, hypoxemia, and hypercarbia on gas exchange between blood and tissue
- Know the effects of hypoxemia on ventilatory function and tissue metabolism

F. Mechanism of breathing

- Understand the possible physiologic effects of chest wall abnormality
- Understand the effects of dynamic compression of airways
- Recognize the effect of respiratory effort on caloric consumption

G. Respiratory physiology at altitude

- Recognize the effects of acute and chronic exposure to high altitude on oxygen delivery
- Know the effects of altitude on cardiovascular function

H . Effects of mechanical ventilation on CV performance

- Understand the effects of positive end-expiratory pressure and inspiratory pressures on cardiac output and their influence on right and left ventricular function
- Understand appropriate use of mechanical ventilation
- Know the general principles of how the mode of ventilation affects cardiac output

Pharmacology

A. Pharmacologic basis for therapy of cardiovascular disease

- Understand the principles of pharmacokinetics, including drug absorption, distribution, biotransformation, and excretion
- Understand the principles of pharmacodynamics, including the loci of drug actions, role of receptors, and dose-response relationships
- Understand drug-drug interactions, adverse reactions, and off-target effects
- Understand the principles of maternal-fetal pharmacodynamics and pharmacokinetics
- Understand the basic principles of developmental pharmacology
- Understand the role of pharmacogenomics in drug response
- Understand the principles involved in clinical trials and drug regulation and development

B. Antiarrhythmic drugs

1. Class I antiarrhythmic drugs :

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of Class I antiarrhythmic drugs
- Know the mechanism of action for Class I antiarrhythmic drugs
- Identify indications for Class I antiarrhythmic drugs
- Identify contraindications for Class I antiarrhythmic drugs
- Plan therapy including appropriate dose and monitoring for Class I antiarrhythmic drugs
- Recognize the drug adverse effects and toxicity of Class I antiarrhythmic drugs
- Recognize potential drug-drug interactions for Class I antiarrhythmic drugs

2. Class II antiarrhythmic drugs :

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of Class II antiarrhythmic drugs
- Know the mechanism of action for Class II antiarrhythmic drugs
- Identify Indications for Class II antiarrhythmic drugs
- Identify contraindications for Class II antiarrhythmic drugs
- Plan therapy including appropriate dose and monitoring for Class II antiarrhythmic drugs
- Recognize the drug adverse effects and toxicity of Class II antiarrhythmic drugs
- Recognize potential drug-drug interactions for Class II antiarrhythmic drugs

3. Class III drugs :

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of Class III antiarrhythmic drugs
- Know the mechanism of action for Class III antiarrhythmic drugs
- Identify indications for Class III antiarrhythmic drugs
- Identify contraindications for Class III antiarrhythmic drugs
- Plan therapy including appropriate dose and monitoring for Class III antiarrhythmic drugs
- Recognize the drug adverse effects and toxicity of Class III antiarrhythmics
- Recognize potential drug-drug interactions for Class III antiarrhythmic drugs

4. Class IV antiarrhythmic drugs :

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of Class IV antiarrhythmic drugs
- Know the mechanism of action for Class IV antiarrhythmic drugs
- Identify indications for Class IV antiarrhythmic drugs
- Identify contraindications for Class IV antiarrhythmic drugs
- Plan therapy including appropriate dose and monitoring for Class IV antiarrhythmic drugs
- Recognize the drug adverse effects and toxicity of Class IV antiarrhythmics
- Recognize potential drug-drug interactions for Class IV antiarrhythmic drugs

5. Adenosine :

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of adenosine
- Know the mechanism of action for adenosine
- Identify indications for adenosine
- Identify contraindications for adenosine
- Plan therapy including appropriate dose and monitoring for adenosine
- Recognize the drug adverse effects and toxicity of adenosine
- Recognize potential drug-drug interactions for adenosine

C. Inotropic agents

1. Digitalis and ATPase inhibitors

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of digitalis and ATPase inhibitors
- Know the mechanism of action for digitalis and ATPase inhibitors

- Identify indications for digitalis and ATPase inhibitors
- Identify contraindications for digitalis and ATPase inhibitors
- Plan therapy including appropriate dose and monitoring for digitalis and ATPase inhibitors
- Recognize the drug adverse effects and toxicity of digitalis and ATPase inhibitors
- Recognize potential drug-drug interactions for digitalis and ATPase inhibitors

2. Catecholamines

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of catecholamines
- Know the mechanism of action for catecholamines
- Identify indications for catecholamines
- Identify contraindications for catecholamines
- Plan therapy including appropriate dose and monitoring for catecholamines
- Recognize the drug adverse effects and toxicity of catecholamines
- Recognize potential drug-drug interactions for catecholamines

3. Phosphodiesterase inhibitors

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of phosphodiesterase inhibitors
- Know the mechanism of action for phosphodiesterase inhibitors
- Identify indications for phosphodiesterase inhibitors
- Identify contraindications for phosphodiesterase inhibitors
- Plan therapy including appropriate dose and monitoring for phosphodiesterase inhibitors
- Recognize the drug adverse effects and toxicity of phosphodiesterase inhibitors

- Recognize potential drug-drug interactions for phosphodiesterase inhibitors

4. Calcium sensitizers

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of calcium sensitizers
- Know the mechanism of action for calcium sensitizers
- Identify indications for calcium sensitizers
- Identify contraindications for calcium sensitizers
- Plan therapy including appropriate dose and monitoring for calcium sensitizers
- Recognize the drug adverse effects and toxicity of calcium sensitizers
- Recognize potential drug-drug interactions for calcium sensitizers

D. Systemic vasoactive agents

1. Nitrates

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of nitrates
- Know the mechanism of action for nitrates
- Identify indications for nitrates
- Identify contraindications for nitrates
- Plan therapy including appropriate dose and monitoring for nitrates
- Recognize the drug adverse effects and toxicity of nitrates
- Recognize potential drug-drug interactions for nitrates

2. Calcium channel antagonists

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of calcium channel antagonists

- Know the mechanism of action for calcium channel antagonists
- Identify indications for calcium channel antagonists
- Identify contraindications for calcium channel antagonists
- Plan therapy including appropriate dose and monitoring for calcium channel antagonists
- Recognize the drug adverse effects and toxicity of calcium channel antagonists
- Recognize potential drug-drug interactions for calcium channel antagonists

3. Angiotensin-converting enzyme (ACE) inhibitors

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of ACE inhibitors
- Know the mechanism of action for ACE Inhibitors
- Identify indications for ACE inhibitors
- Identify contraindications for ACE inhibitors
- Plan therapy including appropriate dose and monitoring for ACE inhibitors

4. Beta-adrenergic blocking drugs

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of β -adrenergic blocking drugs
- Know the mechanism of action for β -adrenergic blocking drugs
- Identify indications for β -adrenergic blocking drugs
- Identify contraindications for β -adrenergic blocking drugs
- Plan therapy including appropriate dose and monitoring for β -adrenergic blocking drugs
- Recognize the drug adverse effects and toxicity of β -adrenergic blocking drugs
- Recognize potential drug-drug interactions for β -adrenergic blocking drugs

5. Angiotensin-receptor blockers (ARBs)

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of ARBs
- Know the mechanism of action for ARBs
- Identify indications for ARBs
- Identify contraindications for ARBs
- Plan therapy including appropriate dose and monitoring for ARBs
- Recognize the drug adverse effects and toxicity of ARBs
- Recognize potential drug-drug interactions for ARBs

6. Fenoldopam

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of fenoldopam
- Know the mechanism of action for fenoldopam
- Identify indications for fenoldopam
- Identify contraindications for fenoldopam
- Plan therapy including appropriate dose and monitoring for fenoldopam
- Recognize the drug adverse effects and toxicity of fenoldopam
- Recognize potential drug-drug interactions for fenoldopam

7. Vasopressin

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of vasopressin
- Know the mechanism of action for vasopressin
- Identify indications for vasopressin
- Identify contraindications for vasopressin

- Plan therapy including appropriate dose and monitoring for vasopressin
- Recognize the drug adverse effects and toxicity of vasopressin
- Recognize potential drug-drug interactions for vasopressin

E. Pulmonary vasoactive agents

1. Prostacyclin, epoprostenol, sildenafil, bosentan, etc.

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of pulmonary vasodilators
- Know the mechanism of action for pulmonary vasodilators
- Identify indications for pulmonary vasodilators
- Identify contraindications for pulmonary vasodilators
- Plan therapy including appropriate dose and monitoring for pulmonary vasodilators
- Recognize the drug adverse effects and toxicity of pulmonary vasodilators
- Recognize potential drug-drug interactions for pulmonary vasodilators

F. Diuretics

1. Loop diuretics

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of loop diuretics
- Know the mechanism of action for loop diuretics
- Identify indications for loop diuretics
- Identify contraindications for loop diuretics
- Plan therapy including appropriate dose and monitoring for loop diuretics
- Recognize the drug adverse effects and toxicity of loop diuretics

- Recognize potential drug-drug interactions for loop diuretics

2. Thiazides

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of thiazides
- Know the mechanism of action for thiazides
- Identify indications for thiazides
- Identify contraindications for thiazides
- Plan therapy including appropriate dose and monitoring for thiazides
- Recognize the drug adverse effects and toxicity of thiazides
- Recognize potential drug-drug interactions for thiazides

3. Carbonic anhydrase inhibitors

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of carbonic anhydrase inhibitors
- Know the mechanism of action for carbonic anhydrase inhibitors
- Identify indications for carbonic anhydrase inhibitors
- Identify contraindications for carbonic anhydrase inhibitors
- Plan therapy including appropriate dose and monitoring for carbonic anhydrase inhibitors
- Recognize the drug adverse effects and toxicity of carbonic anhydrase inhibitors
- Recognize potential drug-drug interactions for carbonic anhydrase inhibitors

4. Potassium-sparing diuretics

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of potassium-sparing diuretics

- Know the mechanism of action for potassium-sparing diuretics
- Identify indications for potassium-sparing diuretics
- Identify contraindications for potassium-sparing diuretics
- Plan therapy including appropriate dose and monitoring for potassium-sparing diuretics
- Recognize the drug adverse effects and toxicity of potassium-sparing diuretics
- Recognize potential drug-drug interactions for potassium-sparing diuretics

5. B-type natriuretic peptides

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of b-type natriuretic peptides
- Know the mechanism of action for b-type natriuretic peptides
- Identify indications for b-type natriuretic peptides
- Identify contraindications for b-type natriuretic peptides
- Plan therapy including appropriate dose and monitoring for b-type natriuretic peptides
- Recognize the drug adverse effects and toxicity of b-type natriuretic peptides
- Recognize potential drug-drug interactions for b-type natriuretic peptides

G. Anti-inflammatory agents

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of anti-inflammatory agents
- Know the mechanism of action of anti-inflammatory agents
- Identify indications for anti-inflammatory agents
- Identify contraindications for anti-inflammatory agents

- Plan therapy including appropriate dose and monitoring for anti-inflammatory agents
- Recognize the drug adverse effects and toxicity of anti-inflammatory agents
- Recognize potential drug-drug interactions for anti-inflammatory agents

H. Antiplatelet/anticoagulant therapy

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of antithrombic/anticoagulant agents
- Know the mechanism of action for antithrombic/anticoagulant agents
- Identify indications for antithrombic/anticoagulant agents
- Identify contraindications for antithrombic/anticoagulant agents
- Plan therapy including appropriate dose and monitoring for antithrombic/anticoagulant agents
- Recognize the drug adverse effects and toxicity of antithrombic/anticoagulant agents
- Recognize potential drug-drug interactions for antithrombic/anticoagulant agents

I. Lipid-lowering drugs

1. Bile acid sequestrants

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of lipid-reducing agents
- Know the mechanism of action for lipid-reducing agents
- Identify indications for lipid-reducing agents
- Identify contraindications for lipid-reducing agents
- Plan therapy including appropriate dose and monitoring for lipid-reducing agents
- Recognize the drug adverse effects and toxicity of lipid-reducing agents

- Recognize potential drug-drug interactions for lipid-reducing agents

2. HMG CoA reductase inhibitors

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of HMG CoA reductase inhibitors
- Know the mechanism of action for HMG CoA reductase inhibitors
- Identify indications for HMG CoA reductase inhibitors
- Identify contraindications for HMG CoA reductase inhibitors
- Plan therapy including appropriate dose and monitoring for HMG CoA reductase inhibitors
- Recognize the drug adverse effects and toxicity of HMG CoA reductase inhibitors
- Recognize potential drug-drug interactions for HMG CoA reductase inhibitors

3. Glycoprotein IIb/IIIa inhibitors

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of glycoprotein IIb/IIIa inhibitors
- Know the mechanism of action for glycoprotein IIb/IIIa inhibitors
- Identify indications for glycoprotein IIb/IIIa inhibitors
- Identify contraindications for glycoprotein IIb/IIIa inhibitors
- Plan therapy including appropriate dose and monitoring for glycoprotein IIb/IIIa inhibitors
- Recognize the drug adverse effects and toxicity of glycoprotein IIb/IIIa inhibitors
- Recognize potential drug-drug interactions for glycoprotein IIb/IIIa inhibitors

J. Ductal arteriosus drugs

1. Prostaglandins

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of prostaglandin E (PGE)
- Know the mechanism of action for PGE
- Identify indications for PGE
- Identify contraindications for PGE
- Plan therapy including appropriate dose and monitoring for PGE
- Recognize the drug adverse effects and toxicity of PGE
- Recognize potential drug-drug interactions for PGE

2. Indomethacin and ibuprofen

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of indomethacin/ibuprofen
- Know the mechanism of action for indomethacin/ibuprofen
- Identify indications for indomethacin/ibuprofen
- Identify contraindications for indomethacin/ibuprofen
- Plan therapy including appropriate dose and monitoring for indomethacin/ibuprofen
- Recognize the drug adverse effects and toxicity of indomethacin/ibuprofen
- Recognize potential drug-drug interactions for indomethacin/ibuprofen

K. Specific sedative, hypnotic, and analgesic drugs

1. Barbiturates

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of barbiturates
- Know the mechanism of action of barbiturates

- Identify indications for barbiturates
- Identify contraindications for barbiturates
- Plan therapy including appropriate dose and monitoring for barbiturates
- Recognize the drug adverse effects and toxicity of barbiturates
- Recognize potential drug-drug interactions for barbiturates

2. Benzodiazepines and antagonists (eg, diazepam, midazolam, flumazenil)

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of benzodiazepines and antagonists
- Know the mechanism of action for benzodiazepines and antagonists
- Identify indications for benzodiazepines and antagonists
- Identify contraindications for benzodiazepines and antagonists
- Plan therapy including appropriate dose and monitoring for benzodiazepines and antagonists
- Recognize the drug adverse effects and toxicity of benzodiazepines and antagonists
- Recognize potential drug-drug interactions for benzodiazepines and antagonists

3. Non-barbiturates/non-benzodiazepines (eg, etomidate, ketamine)

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of non-barbiturate/non-benzodiazepine agents
- Know the mechanism of action for non-barbiturate/non-benzodiazepine agents
- Identify indications for non-barbiturate/non-benzodiazepine agents
- Identify contraindications for non-barbiturate/non-benzodiazepine agents

- Plan therapy including appropriate dose and monitoring for non-barbiturate/non-benzodiazepine agents
- Recognize the drug adverse effects and toxicity of non-barbiturate/non-benzodiazepine agents
- Recognize potential drug-drug interactions for non-barbiturate/non-benzodiazepine agents

4. Opioids (eg, morphine, fentanyl, meperidine, sufentanil, methadone)

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of opioids
- Know the mechanism of action for opioids
- Identify indications for opioids
- Identify contraindications for opioids
- Plan therapy including appropriate dose and monitoring for opioids
- Recognize the drug adverse effects and toxicity of opioids
- Recognize potential drug-drug interactions for opioids

5. Psychotropic drugs

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of psychotropic drugs
- Know the mechanism of action for psychotropic drugs
- Identify indications for psychotropic drugs
- Identify contraindications for psychotropic drugs
- Plan therapy including appropriate dose and monitoring for psychotropic drugs
- Recognize the drug adverse effects and toxicity of psychotropic drugs
- Recognize potential drug-drug interactions for psychotropic drugs

6. Local anesthetics (eg, lidocaine, mepivacaine)

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of local anesthetics
- Know the mechanism of action for local anesthetics
- Identify indications for local anesthetics
- Identify contraindications for local anesthetics
- Plan therapy including appropriate dose and monitoring for local anesthetics
- Recognize the drug adverse effects and toxicity of local anesthetics
- Recognize potential drug-drug interactions for local anesthetics

L. Anti-cholinergic drugs

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of anti-cholinergic drugs
- Know the mechanism of action for anti-cholinergic drugs
- Identify indications for anti-cholinergic drugs
- Identify contraindications for anti-cholinergic drugs
- Plan therapy including appropriate dose and monitoring for anti-cholinergic drugs
- Recognize the drug adverse effects and toxicity of anti-cholinergic drugs
- Recognize potential drug-drug interactions for anti-cholinergic drugs

M. Neuromuscular blocking agents

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of neuromuscular blocking drugs
- Know the mechanism of action for neuromuscular blocking drugs
- Identify indications for neuromuscular blocking drugs
- Identify contraindications for neuromuscular blocking drugs
- Plan therapy including appropriate dose and monitoring for neuromuscular blocking drugs

- Recognize the drug adverse effects and toxicity of neuromuscular blocking drugs
- Recognize potential drug-drug interactions for neuromuscular blocking drugs

N. Inhalation anesthetics

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of inhalation anesthetics
- Know the mechanism of action for inhalation anesthetics
- Identify indications for inhalation anesthetics
- Identify contraindications for inhalation anesthetics
- Plan therapy including appropriate dose and monitoring for inhalation anesthetics
- Recognize the drug adverse effects and toxicity of inhalation anesthetics
- Recognize potential drug-drug interactions for inhalation anesthetics

O. Antireflux drugs

- Understand the cardiovascular effects of antireflux drugs, including contraindications and interactions with other drugs
- Know the mechanism of action for antireflux drugs
- Identify indications for antireflux drugs
- Identify contraindications for antireflux drugs
- Plan therapy including appropriate dose and monitoring for antireflux drugs
- Recognize the drug adverse effects and toxicity of antireflux drugs
- Recognize potential drug-drug interactions for antireflux drugs

P. Enzyme replacement therapy for Pompe, Fabry, Hurler

- Know the pharmacologic effects (pharmacokinetics and pharmacodynamics) of enzyme replacement therapy

- Know the mechanism of action for enzyme replacement therapy
- Identify indications for enzyme replacement therapy
- Identify contraindications for enzyme replacement therapy
- Plan therapy including appropriate dose and monitoring for enzyme replacement therapy
- Recognize the drug adverse effects and toxicity of enzyme replacement therapy
- Recognize potential drug-drug interactions for enzyme replacement therapy

Q. Cardiovascular effects of drug abuse

- Recognize and manage the cardiovascular effects of drug abuse (eg, cocaine, diet pills, hallucinogens, inhalants, stimulants, anabolic steroids)

Cardiovascular Examination, Principles, and Application of Cardiac Diagnostics

A. Physical examination

1. Heart rate

- Know the age-related normal measurements of heart rate associated with disease states and medications
- Understand alterations in heart rate and types of rhythm associated with disease states and medications

2. Vasculature including arterial and venous pulses, venous congestion, and blood pressure

- Know significance of differences in pulse amplitude between extremities
- Understand the physiology of paradoxical pulse
- Understand the significance of a widened pulse pressure

- Know the age-related changes in blood pressure values
- Know the different methods of determination of blood pressure and the potential associated artifacts
- Understand the physiologic events related to the jugular venous pulse and causes for variation
- Know the principles that underlie the assessment of perfusion (eg, temperature, capillary refilling, color)
- Recognize the clinical signs of systemic venous congestion and know the significance of peripheral edema in patients with cardiac disease

3. Murmurs

- Understand the physical basis of murmurs, thrills, and ventricular heaves
- Know characteristics of normal and abnormal heart sounds with respect to physiologic events and timing in the cardiac cycle
- Recognize the characteristics of the various types of functional ("innocent") murmurs
- Understand the significance of localization and transmission of cardiac murmurs
- Know how to interpret extracardiac bruits
- Understand the significance of friction rubs
- Know the various characteristics of pathologic murmurs, clicks, and cardiac sounds.
- Interpret clinical physical examination data influenced by cardiac and body position

4. Respiratory pattern

- Recognize the clinical signs of pulmonary congestion
- Know the clinical significance of abnormal respiratory patterns (eg, tachypnea, hyperpnea, stridor, grunting, retractions, wheezing)
- 5. Cyanosis and other skin manifestations of cardiac disease

- Know the cardiac and noncardiac causes of central cyanosis
- Understand the physiologic significance of central versus peripheral cyanosis
- Know the significance of jaundice in a cardiac patient
- Know the dermatologic abnormalities in a patient with cardiac disease and their pathogenesis
- Know the clinical manifestations and significance of embolic phenomena in patients with cardiac disease
- Recognize and understand the importance of variations in hepatic situs

B. Surface electrocardiography

Age-dependent features

- Know age-related changes in ECG wave forms and intervals Hypertrophy
- Recognize the ECG pattern of ventricular hypertrophy at various ages
- Recognize atrial enlargement on ECG

Depolarization

- Recognize variations from normal pattern of atrial depolarization on ECG and make an interpretation
- Recognize variations from normal pattern of ventricular depolarization on ECG and make an interpretation
- Differentiate the ECG patterns associated with preexcitation, bundle branch block, and hemiblock

4. Repolarization

- Recognize on ECG variations from normal pattern of ventricular repolarization and make an interpretation

5. Clinical applications

- Recognize patterns of ischemia, injury, and infarction

6. Monitoring

- Know the indications for 24-hour ambulatory ECG recording, how to recognize artifacts, and how to interpret the results
- Know the indications for use of an event monitor or an implantable loop recorder and how to interpret the results

C. Exercise stress testing

- Know the guidelines for exercise in normal children
- Know the guidelines for exercise in children with cardiovascular disease
- Recognize the normal responses to exercise in terms of heart rate, blood pressure, cardiac output, oxygen uptake and consumption, and venous return
- Understand the ventilatory response to CO₂ in terms of CO₂ response curves and central and peripheral chemoreceptors
- Know the indications for and risks of exercise testing in children
- Understand the techniques, physiology, advantages, and disadvantages of the different types of exercise (cycle, treadmill, hand-grip exercise)
- Understand the physiologic principles related to electrocardiographic responses to exercise
- Understand the physiologic principles involved in the ventilatory response to exercise
- Understand the indications of nuclear medicine stress testing

D. Echocardiography/Doppler methods (includes fetal)

- . Assess systolic and diastolic function utilizing echocardiography

- Know how to determine gradients and pressure measurement from Doppler-derived velocity measurements
- Know how Doppler-derived velocity measurements compare to direct-pressure gradient determinations
- Understand the principles of echocardiography
- Understand the physics of echocardiography
- Know the indications for, risks of, and limitations of transesophageal, stress, and fetal echocardiography
- Recognize normal cardiac anatomy on echocardiography

E. Catheterization and intervention

1. General principles

- Know the indications and contraindications for and risks of cardiac catheterization
- Know the most appropriate positional view to obtain optimal angiographic visualization of the targeted cardiac and vasculature structure of interest
- Interpret normal and abnormal pressure data during cardiac catheterization
- Know the normal and potential abnormal courses of a cardiac catheter during cardiac catheterization and angiography

2. Calculating cardiac output and shunts

Invasive and noninvasive methods of calculating cardiac output

- Know how to calculate myocardial oxygen consumption from data measuring coronary blood flow and oxygen saturation
- Understand the concept, use, and limitations of the Fick method to determine blood flow (systemic and pulmonary)
- Calculate a right-to-left and a left-to-right shunt given relevant oxygen data
- Know how to arrive at a physiologic diagnosis given saturation data

- Understand the concept of effective pulmonary blood flow
- Recognize important sources of measurement error when quantifying ventricular function by invasive methods

3. Interventional catheterization: balloon angioplasty/valvuloplasty/stent placement and angiography

- Know which lesions can be dilated by angioplasty
- Understand the factors associated with angioplasty (eg, indications, contraindications, risks, and limitations)
- Know how to perform angioplasty of native and postoperative pulmonary branch stenosis
- Manage the complications of angioplasty
- Interpret patterns of pulmonary and systemic vasculature on angiography
- Understand the factors associated with use of angiography (eg, risks, risk management, complications, and contraindications)
- Know the methods for and limitations of calculations of pulmonary and systemic vascular resistance and its application
- Know which valve lesions are candidates for balloon valvuloplasty
- Understand the factors associated with stent placement (eg, indications, contraindications, risks, and limitations)
- Understand the basic technical aspects of stent placement
- Understand medical management implications following stent placement in lesions
- Identify and manage the complications of stent placement
- Understand the factors associated with dilation of bioprosthetic valves/conduits (eg, indications, contraindications, risks, and limitations)

- Understand the factors associated with bioprosthetic valves/conduits (eg, indications, contraindications, risks, and limitations)
- Know how to perform angioplasty of bioprosthetic valves/conduits

4. Transeptal puncture and atrioseptostomy

- Know the indications, contraindications, risks, and limitations of atrioseptostomy
- Understand the basic technical aspects of balloon atrial septostomy
- Understand the factors associated with transeptal puncture (eg, indications, contraindications, risks, and limitations)

5. Occlusion techniques

- Understand the factors associated with occlusion techniques (eg, indications, contraindications, risks, and limitations)
- Understand the basic technical aspects of occlusion techniques
- Recognize commonly approved occlusion devices for cardiac defects
- Plan appropriate management and follow-up evaluation relative to complications of occlusion devices
- Plan prophylactic management of thrombosis following the use of an occlusion device
- Percutaneous valve placement a. Understand the principles of percutaneous valve placement
- Other interventional procedures a. Understand the basic principles and techniques of latest interventional technologies

6. Cardiac magnetic resonance imaging (MRI) and angiography (MRA) and computed tomography (CT) scan

- Understand the factors associated with cardiac CT scan and CT angiography (eg, indications, contraindications, and risks)

- Understand the factors associated with use of cardiac MRI (eg, indications, contraindications, risks, and limitations)
- Diagnose cardiovascular disease based on cardiac computed tomography
- Diagnose cardiac disease based on findings on cardiac MRI
- Know the factors associated with MRI/MRA assessment of cardiovascular function, including flow (eg, indications, techniques, limitations)

7. Nuclear testing

- Know the indications, contraindications, risks, and limitations of radionuclide angiocardigraphy
- Recognize the clinical implications of normal and abnormal findings on lung perfusion scans and ventilation/perfusion scans

H. Other forms of cardiac testing

- Pulse oximetry a. Interpret the principles of pulse oximetry in the evaluation of a patient with cardiovascular disease
- X-ray studies of the chest
- Electrophysiologic testing

I. Electrocardiographic diagnosis

- Recognize electrocardiographic features of first-, second-, and third-degree atrioventricular block
- Recognize electrocardiographic features of atrial and ventricular ectopy

J. Laboratory testing

1. Erythrocyte indices

- Recognize alterations in erythrocyte indices that are important in the evaluation of a patient with cardiovascular disease

2. Arterial blood gases and pH

- Understand factors which influence oxygen-hemoglobin linkage and dissociation curves
- Understand how arterial blood gases and pH are used in the assessment of cardiovascular disease

3. Cardiac injury profiles

- Know the uses of serum creatine kinase activity and troponin I and T concentration measurements in a patient with cardiovascular disease
- Heart failure profiles a. Understand the use and limitations of biomarkers in the evaluation of acute and chronic heart failure

Office-Based Cardiac Problems

A. Syncope

- Know how to evaluate syncope and presyncope
- Diagnose and manage neurocardiogenic syncope
- Know the differential diagnosis of syncope

B. Lipidopathies and coronary risk management

- Know the various types of hyperlipidemias, including manifestations, their genetic basis, mode of transmission, diagnosis, and management
- Interpret serum lipid profile tests in children
- Plan appropriate management of a child with hypercholesterolemia
- Know the recommended daily dietary saturated fat intake for children of different ages

- Know the risk factors for hyperlipidemia and the timing of lipid testing based on risk factors

C. Hypertension

- Recognize and plan an appropriate evaluation in a patient with systemic hypertension
- Plan appropriate management of systemic hypertension
- Understand the natural history of systemic hypertension in children

D. Exercise restrictions in congenital heart disease

- Know the guidelines for exercise in normal children
- Know the guidelines for exercise in children with cardiovascular disease

E. Chest pain

- Plan the diagnosis and management of chest pain in children and adolescents

F. Cardiovascular problems in the athlete

- Know how to use echocardiography to recognize physiologic cardiac hypertrophy in an athlete, including differentiation from pathologic hypertrophy
- Understand and recognize cardiovascular and electrocardiographic changes (eg, heart rate, blood pressure, LV mass) in a well-trained athlete
- Identify the cause(s) of sudden cardiac death in an athlete
- Understand utilization and limitations of cardiovascular screening of the athlete and school-aged child

G. Cyanosis

- Recognize manifestations of acute and chronic insufficient pulmonary blood flow

H. Palpitations

- Plan the evaluation and management of palpitations in children and adolescents

I. Murmurs

Left-to-Right Shunts

Atrial septal defects (non-AVSD types)

1. Anatomy

- Recognize the anatomic characteristics of different types of atrial septal defects
- Recognize cardiovascular lesions commonly associated with an atrial septal defect

2. Physiology a. Understand the factors that affect shunting at the atrial level

3. Natural history

- Understand the short- and long-term effects of an atrial septal defect on pulmonary vascular bed and cardiac function
- Understand the relationship between an atrial septal defect and arrhythmia
- Understand the relationship between an atrial septal defect and strokes

4. Clinical findings

- Recognize the clinical findings consistent with an atrial septal defect

5. Laboratory findings

- Recognize features associated with atrial septal defect using available laboratory tests and recognize important anatomic features that could affect surgical management
- Calculate pulmonary and systemic flows, blood flow ratios, and resistance by various modalities in a patient with atrial septal defect
- Recognize the cardiac MRI features associated with each type of atrial septal defect

6. Management, including complications

- Develop an appropriate management plan for a patient with an atrial septal defect
- Determine the appropriate timing of surgical or catheter intervention in a patient with an atrial septal defect
- Identify and manage the early and long-term complications of surgical or catheter closure of an atrial septal defect

Atrioventricular septal defects

1. Embryology, epidemiology, and genetics

- Recognize the genetic syndromes associated with atrioventricular septal defect

2. Anatomy

- Recognize cardiovascular lesions commonly associated with atrioventricular septal defect including varying AVV morphology and insertion

3. Physiology

- Identify the effects of an atrioventricular septal defect on the pulmonary vascular bed
- Understand the factors that determine shunting at atrial and ventricular levels in atrioventricular septal defect

4. Natural history a. Understand the natural history of atrioventricular septal defect

5. Clinical findings a. Recognize the clinical findings consistent with an atrioventricular septal defect

6. Laboratory findings

- Recognize features of atrioventricular septal defects using available laboratory tests and recognize important anatomic features that could affect surgical management
- Evaluate pulmonary pressures in a patient with atrioventricular septal defect
- Recognize the various atrioventricular valve morphologies and attachments in a patient with atrioventricular septal defect

7. Management, including complications

- Recognize implications of straddling and overriding of atrioventricular valves on management decisions
- Plan appropriate medical management of a patient with an atrioventricular septal defect
- Plan the appropriate timing of surgery in a patient with an atrioventricular septal defect
- Recognize and manage early and long-term complications of surgical repair of an atrioventricular septal defect
- Recognize and manage the complications of an unoperated atrioventricular septal defect

Non-AVSD Ventricular septal defects

1. Embryology, epidemiology, and genetics

- Recognize specific genetic syndromes associated with ventricular septal defect

2. Anatomy

- Know the anatomic location of various types of ventricular septal defects
- Recognize cardiovascular lesions commonly associated with ventricular septal defect

3. Physiology

- Identify the effects of a ventricular septal defect on the pulmonary vascular bed
- Understand the effects of ventricular septal defect on cardiac function
- Understand the vascular and cardiac factors that determine shunting in a ventricular septal defect

4. Natural history a. Understand the natural history of ventricular septal defect

5. Clinical findings

- Differentiate between a closing VSD and development of subpulmonary obstruction
- Recognize and treat pulmonary arterial hypertension
- Recognize the clinical findings associated with a ventricular septal defect
- Recognize the clinical findings of commonly associated cardiovascular lesions with a ventricular septal defect (eg, aortic insufficiency, patent ductus arteriosus, double-chambered right ventricle)

6. Laboratory findings

- Recognize the anatomic types of features of ventricular septal defect using available laboratory tests and recognize important anatomic features that could affect surgical management
- Distinguish between restrictive and nonrestrictive communications by Doppler echocardiography in a patient with a ventricular septal defect

7. Management, including complications

- Recognize and manage the early and long-term complications following surgical repair or catheter device closure of a ventricular septal defect
- Plan management of a patient with VSD and aortic regurgitation

- Plan appropriate medical management of a patient with ventricular septal defect
- Plan the appropriate timing of surgical or catheter intervention in the management of a patient with ventricular septal defect
- Recognize and manage the complications of unoperated ventricular septal defect

D. Patent ductus arteriosus

1. Embryology, epidemiology, and genetics

- Know the embryologic basis of patent ductus arteriosus

2. Anatomy

- Recognize the anatomic details of patent ductus arteriosus
- Recognize lesions commonly associated with patent ductus arteriosus

3. Physiology

- Identify the effects of patent ductus arteriosus on the pulmonary vascular bed
- Recognize the effects of gestational age at birth and postnatal age on the presentation of a patent ductus arteriosus
- Understand the effects of a patent ductus arteriosus on cardiac function
- Understand the determinants of shunting in patent ductus arteriosus

4. Natural history a. Understand the natural history of patent ductus arteriosus

5. Clinical findings

- Recognize the clinical findings associated with patent ductus arteriosus

6. Laboratory findings

- Recognize features of patent ductus arteriosus of various sizes using available laboratory tests and recognize important anatomic features that could affect surgical management
- Assess volume overload and estimate pulmonary arterial pressures by echocardiography in a patient with patent ductus arteriosus

7. Management, including complications

- Plan management of patent ductus arteriosus in preterm and term infants, including appropriate use of prostaglandin inhibitors
- Plan the timing of surgical or catheter intervention in a patient with patent ductus arteriosus
- Recognize possible early and long-term complications of surgical or transcatheter repair of patent ductus arteriosus
- Recognize and manage the complications of untreated patent ductus arteriosus
- Understand the relationship between patent ductus arteriosus and necrotizing enterocolitis in preterm and full-term infants

Coronary arteriovenous fistula

1. Anatomy

- Understand the pathologic features of a coronary arteriovenous fistula

2. Physiology

- Understand the vascular physiology of a large coronary arteriovenous fistula

3. Natural history a. Understand the natural history of coronary arteriovenous fistula

4. Clinical findings a. Recognize the clinical findings of coronary arteriovenous fistula

5. Laboratory findings a. Recognize features associated with coronary arteriovenous fistula using available laboratory tests and recognize important anatomic features that could affect surgical management

6. Management, including complications

- Plan the appropriate technique and timing of surgical or catheter intervention in a patient with coronary arteriovenous fistula
- Identify and manage possible complications of surgical or transcatheter repair of coronary arteriovenous fistula
- Recognize and manage the complications of an untreated arteriovenous fistula

Aortopulmonary window

1. Embryology, epidemiology, and genetics

- Know the embryologic basis of aortopulmonary window

2. Anatomy

- Recognize the anatomic details of an aortopulmonary window
- Recognize lesions commonly associated with an aortopulmonary window

3. Physiology

- Identify the effects of an aortopulmonary window on the pulmonary vascular bed

4. Natural history

- Understand the natural history of an unoperated aortopulmonary window

5. Clinical findings

- Recognize the clinical presentation of aortopulmonary window

6. Laboratory findings

- Recognize features consistent with a diagnosis of aortopulmonary window by available laboratory tests and recognize important features that could affect surgical management

7. Management, including complications

- Plan the appropriate timing of surgical or catheter intervention in a patient with aortopulmonary window
- Recognize and manage the long-term complications of unoperated aortopulmonary window

Right-to-Left Shunts

A. Tetralogy of Fallot

1. Embryology, epidemiology, and genetics

- Know the embryology, epidemiology, and genetics for tetralogy of Fallot
- Recognize genetic syndromes associated with tetralogy of Fallot

2. Anatomy

- Recognize the commonly associated lesions in a patient with tetralogy of Fallot
- Recognize the anatomic features in a patient with tetralogy of Fallot

3. Physiology

- Understand the circulatory abnormalities in a patient with tetralogy of Fallot, including the pathophysiology of a hypercyanotic episode

4. Natural history a. Know the natural history of tetralogy of Fallot

5. Clinical findings

- Recognize the clinical features of hypercyanotic episodes in patients with tetralogy of Fallot

6. Laboratory findings

- Appropriately use and interpret diagnostic studies for evaluation and treatment planning in tetralogy of Fallot
- Recognize hemodynamic and angiographic findings of tetralogy of Fallot

7. Management, including complications

- Plan management of a hypercyanotic episode in a patient with tetralogy of Fallot
- Plan the treatment approach for palliation or correction of tetralogy of Fallot
- Recognize the complications of cyanosis in untreated tetralogy of Fallot
- Recognize and manage complications after treatment of tetralogy of Fallot

Double-outlet right ventricle

1. Embryology, epidemiology, and genetics

- Understand the etiology, epidemiology, and genetic syndromes associated with double-outlet right ventricle

2. Anatomy

- Recognize the anatomic features of double-outlet right ventricle and commonly associated lesions

3. Physiology

- Understand the circulatory physiology of double-outlet right ventricle and its relationship with anatomic features

4. Laboratory findings

- Appropriately use and interpret diagnostic studies for evaluation and treatment planning in double-outlet right ventricle

5. Management, including complications

- Recognize the effects of the transitional circulation on the clinical presentation of double-outlet right ventricle
- Plan the treatment of double-outlet right ventricle based on anatomic and physiological variables
- Recognize and manage the early and long-term complications after therapy in a patient with double-outlet right ventricle

Pulmonary atresia with intact septum

1. Embryology, epidemiology, and genetics

- Know the embryology, epidemiology, and genetics of pulmonary atresia with intact septum
- Recognize the etiology, epidemiology, and genetic syndromes associated with pulmonary atresia with intact septum

2. Anatomy

- Recognize the anatomic features and their prognostic significance in pulmonary atresia with intact septum
- Recognize cardiovascular lesions commonly associated with pulmonary atresia with intact septum

3. Physiology

- Understand the physiologic consequences of the anatomic spectrum of pulmonary atresia with intact septum

4. Natural history

- Understand the range of natural history in pulmonary atresia with intact septum

5. Laboratory findings

- Appropriately use and interpret diagnostic studies for evaluation and treatment planning in pulmonary atresia with intact ventricular septum before and after intervention.

6. Management, including complications

- .Plan the treatment of pulmonary atresia with intact septum
- b. Recognize and manage early and long-term complications of therapy in pulmonary atresia with intact septum

Pulmonary atresia with ventricular septal defect

1. Embryology, epidemiology, and genetics

- Know the embryology, epidemiology, and genetics of pulmonary atresia with ventricular septal defect
- Recognize the etiology, epidemiology, and genetic syndromes associated with pulmonary atresia with ventricular septal defect

2. Anatomy

- Recognize the abnormalities of the pulmonary vascular bed in pulmonary atresia with ventricular septal defect
- Recognize lesions commonly associated with pulmonary atresia with ventricular septal defect

3. Physiology

- Understand the consequences of anatomic variants of pulmonary atresia with ventricular septal defect on treatment and prognosis

4. Natural history a. Understand the range of natural history in pulmonary atresia with ventricular septal defect

5. Laboratory findings a. Recognize features associated with pulmonary atresia with ventricular septal defect using available laboratory tests and recognize important anatomic features that could affect surgical management

6. Management, including complications

- Plan the treatment of pulmonary atresia with ventricular septal defect

- Recognize and manage early and long-term complications of therapy in pulmonary atresia with ventricular septal defect
- Recognize and manage a patient with unoperated pulmonary atresia and ventricular septal defect

Absent pulmonary valve syndrome

1. Embryology, epidemiology, and genetics

- Recognize the etiology, epidemiology, and genetic syndromes associated with absent pulmonary valve syndrome

2. Anatomy

- Recognize the anatomic features and associated lesions in a patient with absent pulmonary valve syndrome

3. Physiology

- Understand the physiologic abnormalities in absent pulmonary valve syndrome

4. Natural history

- Understand the natural history of absent pulmonary valve syndrome

5. Clinical findings

- Recognize the clinical features of absent pulmonary valve syndrome

6. Laboratory findings

- Appropriately use and interpret diagnostic studies for evaluation and treatment planning in pulmonary atresia with absent pulmonary valve syndrome before and after intervention.

7. Management, including complications

- Plan the surgical approach for palliation or correction of absent pulmonary valve syndrome
- Recognize and manage the short- and long-term airway complications associated with absent pulmonary valve syndrome

Single Ventricular Lesions

A. Hypoplastic left heart syndrome

1. Embryology, epidemiology, and genetics a. Recognize the etiology, epidemiology, and genetic syndromes associated with hypoplastic left heart syndrome

2. Anatomy

- Identify anatomic features of hypoplastic left heart syndrome

3. Physiology

- Understand the physiology of hypoplastic left heart syndrome
- Understand the circulatory and metabolic effects of hypoplastic left heart syndrome
- Understand the impact of hypoplastic left heart syndrome and its variants on fetal pulmonary and neurodevelopment.

4. Clinical findings

- Recognize the range of clinical presentation of hypoplastic left heart syndrome and its evolution after birth
- Recognize features of hypoplastic left heart syndrome using available laboratory tests and recognize important anatomic features that could affect surgical management

5. Management, including complications

- Plan appropriate management of obstructed atrial septum in a patient with hypoplastic left heart syndrome
- Recognize the treatment options for hypoplastic left heart syndrome, their merits and drawbacks.
- Plan the management of a neonate with hypoplastic left heart syndrome who has undergone Norwood palliation
- Plan the management of an infant with hypoplastic left heart syndrome who has undergone hybrid palliation

B. Tricuspid atresia

1. Etiology, epidemiology, and genetics

- Understand the embryologic basis of tricuspid atresia

2. Anatomy

- Identify anatomic features of tricuspid atresia and associated lesions

3. Physiology

- Understand the circulatory physiology of tricuspid atresia

4. Natural history

- Understand the natural history of tricuspid atresia

5. Clinical findings

- Recognize the clinical findings in a patient with tricuspid atresia

6. Laboratory findings

- Recognize features of tricuspid atresia using available laboratory tests and recognize important anatomic features that could affect surgical management

7. Management, including complications

- Plan appropriate medical management for a patient with tricuspid atresia
- Diagnose and manage the postoperative complications following surgical palliation of tricuspid atresia

Other forms of single (univentricular) heart

1. Etiology, epidemiology, and genetics

- Understand the developmental basis for a univentricular heart

2. Anatomy

- Identify anatomic features of the various forms of univentricular heart

3. Physiology

- Understand the physiology of the univentricular heart

4. Natural history

- Understand the natural history of univentricular hearts and the impact on surgical decisions

5. Clinical findings a. Recognize the typical clinical findings of univentricular hearts

6. Laboratory findings a. Recognize features associated with univentricular heart using available laboratory tests and recognize important anatomic features that could affect surgical management

7. Management, including complications

- Plan medical management of a patient with univentricular heart
- Plan surgical management of a patient with a univentricular heart
- Manage complications of the natural history and medical therapy of a univentricular heart

- Manage complications of neonatal surgical palliations in univentricular hearts after treatment

The Glenn and Fontan Circulation

1. Etiology, epidemiology, and genetics a. Recognize the indications and contraindications to Glenn and Fontan operations
2. Anatomy a. Identify anatomical variants of Glenn and Fontan circulation
3. Physiology a. Know the physiologic effects of Glenn and Fontan circulation on the heart and circulation
4. Clinical findings a. Recognize the typical clinical features of a Glenn and Fontan circulation
5. Laboratory findings a. Recognize features associated with Glenn and Fontan circulation using available laboratory tests and recognize important anatomic features that could affect management
6. Management, including complications
 - Recognize and manage the early and long-term complications of a patient with Glenn and Fontan circulation, such as protein-losing enteropathy

Structural, Valvar, and Obstructive Lesions

A. Tricuspid valve

- a. Tricuspid stenosis and regurgitation
- b. Ebstein anomaly of the tricuspid valve
- c. Obstructive lesions of the right ventricular outflow tract, pulmonary valve, and pulmonary branches

- d. Pulmonary valve stenosis
 - e. Pulmonary regurgitation
 - f. Pulmonary branch stenosis
 - g. Mitral stenosis, mitral regurgitation, and mitral valve prolapse
 - h. Obstructive lesions of the left ventricular outflow tract, aortic valve, and aortic
 - i. Bicuspid aortic valve a. Anatomy
 - j. Aortic valve stenosis and regurgitation
 - k. Supravalvar aortic stenosis
- Etiology, epidemiology, and genetics
 - Anatomy
 - Physiology
 - Natural history
 - Clinical findings
 - Laboratory findings
 - Management, including complications

Congenital Abnormalities of the Great Arteries and Aorta

A. Truncus arteriosus

B. Transposition of the great arteries

C. Congenitally corrected transposition of the great arteries

- Etiology, epidemiology, and genetics
- Anatomy
- Physiology
- Natural history
- Clinical findings
- Laboratory findings
- Management, including complications

Aortic root and arch abnormalities

1. Management, including complications a. Recognize and manage root and arch abnormalities associated with connective tissue abnormalities
2. Vascular rings and slings
 - Etiology, epidemiology, and genetics
 - Anatomy
 - Physiology
 - Natural history
 - Clinical findings
 - Laboratory findings
 - Management, including complications

Congenital malformations of the coronary circulation

Anomalous left coronary artery from the pulmonary artery

- Etiology, epidemiology, and genetics
- Anatomy
- Physiology
- Natural history
- Clinical findings
- Laboratory findings
- Management, including complications

Systemic and Pulmonary Venous Abnormalities and Situs Abnormalities

- A. Systemic venous abnormalities
- B. Abnormalities of the pulmonary venous system
- C. Cor triatriatum
- D. Pulmonary venous stenosis/atresia
- E. Situs abnormalities and heterotaxy syndromes
- F. Ectopia cordis

- Etiology, epidemiology, and genetics
- Anatomy
- Physiology
- Natural history
- Clinical findings
- Laboratory findings
- Management, including complications

Disorders of the Myocardium, Pericardium, Endocardium, and Vasculature

A. Cardiomyopathies (including systolic dysfunction, diastolic dysfunction, and hypertrophic)

B. Cardiomyopathy in muscular dystrophies

C. Cardiomyopathies in metabolic diseases (includes storage diseases)

D. Transplant medicine

E. Pericardial diseases

F. Cardiac tumors

G. Pulmonary hypertension

- Etiology, epidemiology, and genetics
- Anatomy
- Physiology
- Natural history
- Clinical findings
- Laboratory findings
- Management, including complications

Heart Function and Disease in the Fetus and Newborn

A. Fetal diagnosis and management of congenital heart disease

B. Fetal arrhythmias

- C. Effects of systemic disease on the fetal heart
- D. Effects of maternal disease on the fetal heart
- E. Transitional physiology and pulmonary hypertension of the newborn
- F. Initial stabilization and management of the newborn with congenital heart disease

Intensive Care Management of Patients with Congenital Heart Disease A.

- Airway support, mechanical ventilation, and effects on congenital heart disease
- B. Low cardiac output state
- C. Cardiopulmonary resuscitation
- D. Acute management of pulmonary hypertension
- E. Multiorgan system management
- F. Quality improvement
- G. Perioperative issues

Arrhythmias

A. General principles

1. Classification

- Formulate a differential diagnosis of rhythm disturbances causing a narrow QRS tachycardia, a wide QRS tachycardia, and bradycardia

2. Symptoms

- Identify the signs and symptoms associated with rhythm abnormalities
- Evaluate a patient who has experienced a cardiac arrest
- Evaluate a family with a history of sudden cardiac death

3. Basis or cause/physiology

- Understand the physiologic consequences of rhythm disturbances
- Understand the mechanisms involved in the genesis of cardiac arrhythmias (eg, re-entry, automaticity, conduction block)

4. Therapy

A. General principles

- Understand the indications for acute and chronic medical management of tachy- and bradyarrhythmias
- Know the mechanical methods (eg, vagal maneuvers; esophageal, external, intracardiac pacing; cardioversion) available for treatment of arrhythmias
- Identify the clinical features and genetic causes of diseases associated with arrhythmias (eg, LQTS, ARVD, Brugada syndrome, CPVT, cardiomyopathies, preexcitation)

B. Autonomic interventions

- Know the techniques for use of vagal maneuvers (including indications, contraindications, risks, and limitations) (eg, Valsalva, ice to face, carotid sinus massage)
- Know the effect of vagal maneuvers in treating cardiac arrhythmias

C. Temporary pacing

- Understand the factors associated with temporary pacing (eg, indications, contraindications, risks, and limitations)
- Understand the basic technical aspects of the different modalities available for temporary pacing

D. Cardioversion/defibrillation

- Understand the factors associated with cardioversion/defibrillation (eg, indications, contraindications, risks, and limitations)
- Understand the basic technical aspects of cardioversion/defibrillation

E. Implantable devices

- Recognize pacing mode and pacemaker malfunction by ECG

- Understand the factors associated with permanent pacing (eg, indications, contraindications, risks, and limitations)
- Understand the factors associated with an implantable cardioverter-defibrillator (eg, indications, contraindications, risks, and limitations)
- Understand the basic technical aspects for insertion of a permanent pacemaker or an implantable cardioverter-defibrillator
- Understand the factors associated with bi-ventricular resynchronization pacing (eg, indications, contraindications, risks, and limitations)

Ectopy

1. Clinical recognition
 - a. Recognize clinical manifestations and significance of ectopy
2. Basis or cause
 - Recognize the association of ectopic atrial tachycardias with surgery for congenital heart disease
3. Management
 - Plan the evaluation and management of a patient with frequent atrial or ventricular ectopy

Supraventricular arrhythmias

1. Sinus tachycardia

- a. Clinical recognition
 - Recognize the clinical features of sinus tachycardia
 - Differentiate sinus tachycardia by surface electrocardiographic criteria
 - Recognize intracardiac electrophysiologic characteristics of sinus tachycardia

b. Basis or cause

- Understand the mechanisms and natural history of sinus tachycardia
- Recognize the association of sinus tachycardia with surgery for congenital heart disease (acute and long-term)
- c. Management
- Recognize and medically manage sinus tachycardia in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)
- Recognize and manage the consequences of long-term sinus tachycardia

2. Ectopic atrial tachycardia

a. Clinical recognition

- Recognize the clinical features of ectopic atrial tachycardia
- Differentiate ectopic atrial tachycardia by surface electrocardiographic criteria
- Recognize intracardiac electrophysiologic characteristics of ectopic atrial tachycardia

b. Basis or cause

- Understand the mechanisms and natural history of ectopic atrial tachycardia
- Recognize the association of certain ectopic atrial tachycardias with surgery for congenital heart disease (acute and long-term)

c. Management

- Recognize and medically manage ectopic atrial tachycardia in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)
- Understand the factors associated with electrophysiologic study (eg, indications, contraindications, risks, and limitations) and catheter- or surgical-based ablation therapy for ectopic atrial tachycardia

- Recognize and manage the consequences of ectopic atrial tachycardia

3. Multifocal atrial tachycardia

a. Clinical recognition

- Recognize the clinical features of multifocal atrial tachycardia
- Differentiate multifocal atrial tachycardia by surface electrocardiographic criteria
- Recognize intracardiac electrophysiologic characteristics of multifocal atrial tachycardia

b. Basis or cause

- Understand the mechanisms and natural history of multifocal atrial tachycardia

c. Management

- Recognize and medically manage multifocal atrial tachycardia in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)
- Understand the factors associated with electrophysiologic study (eg, indications, contraindications, risks, and limitations) and catheter- or surgical-based ablation therapy for multifocal atrial tachycardia
- Recognize and manage the consequences of multifocal atrial tachycardia

4. Atrial flutter (intra-atrial reentry)

a. Clinical recognition

- Recognize the clinical features of atrial flutter
- Differentiate atrial flutter by surface electrocardiographic criteria

- Recognize intracardiac electrophysiologic characteristics of atrial flutter

b. Basis or cause

- Understand the mechanisms and natural history of atrial flutter
- Recognize the association of atrial flutter with surgery for congenital heart disease (acute and long-term)

c. Management

- Recognize and medically manage atrial flutter in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)
- Understand the factors associated with electrophysiologic study (eg, indications, contraindications, risks, and limitations) and catheter- or surgical-based ablation therapy for atrial flutter
- Recognize and manage the consequences of atrial flutter

5. Atrial fibrillation

a. Clinical recognition

- Recognize the clinical features of atrial fibrillation
- Differentiate atrial fibrillation by surface electrocardiographic criteria
- Recognize intracardiac electrophysiologic characteristics of atrial fibrillation

b. Basis or cause

- Understand the mechanisms and natural history of atrial fibrillation
- Recognize the association of atrial fibrillation with surgery for congenital heart disease (acute and long-term)

c. Management

- Recognize and medically manage atrial fibrillation in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)

- Understand the factors associated with electrophysiologic study (eg, indications, contraindications, risks, and limitations) and catheter- or surgical-based ablation therapy for atrial fibrillation
- Recognize and manage the consequences of atrial fibrillation

6. Atrioventricular node reentry

a. Clinical recognition

- Recognize the clinical features of AV node reentry
- Differentiate AV node reentry by surface electrocardiographic criteria
- Recognize intracardiac electrophysiologic characteristics of AV node reentry

b. Basis or cause

- Understand the mechanisms and natural history of AV node reentry

c. Management

- Recognize and medically manage AV node reentry in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)
- Understand the factors associated with electrophysiologic study (eg, indications, contraindications, risks, and limitations) and catheter- or surgical-based ablation therapy for AV node reentry
- Recognize and manage the consequences of AV node reentry

7. Junctional ectopic tachycardia

a. Clinical recognition

- Recognize the clinical features of junctional ectopic tachycardia

- Differentiate junctional ectopic tachycardia by surface electrocardiographic criteria
- Recognize intracardiac electrophysiologic characteristics of junctional ectopic tachycardia

b. Basis or cause

- Understand the mechanisms and natural history of junctional ectopic tachycardia
- Recognize the association of junctional ectopic tachycardia with surgery for congenital heart disease (acute and long-term)

c. Management

- Recognize and medically manage junctional ectopic tachycardia in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)
- Understand the factors associated with electrophysiologic study (eg, indications, contraindications, risks, and limitations) and catheter- or surgical-based ablation therapy for the congenital type of junctional ectopic tachycardia
- Recognize and manage the consequences of junctional ectopic tachycardias

8. Orthodromic reentry via accessory pathway

a. Clinical recognition

- Recognize the clinical features of orthodromic reentry via accessory pathway
- Differentiate orthodromic reentry via accessory pathway by surface electrocardiographic criteria

- Recognize intracardiac electrophysiologic characteristics of orthodromic reentry via accessory pathway

b. Basis or cause

- Understand the mechanisms and natural history of orthodromic reentry via accessory pathway

c. Management

- Recognize and medically manage orthodromic reentry via accessory pathway in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)
- Understand the factors associated with electrophysiologic study (eg, indications, contraindications, risks, and limitations) and catheter- or surgical-based ablation therapy for orthodromic reentry via accessory pathway
- Recognize and manage the consequences of orthodromic reentry via accessory pathway

9. Permanent form of junctional reciprocating tachycardia

a. Clinical recognition

- Recognize the clinical features of the permanent form of junctional reciprocating tachycardia
- Differentiate the permanent form of junctional reciprocating tachycardia by surface electrocardiographic criteria
- Recognize intracardiac electrophysiologic characteristics of the permanent form of junctional reciprocating tachycardia

b. Basis or cause

- Understand the mechanisms and natural history of the permanent form of junctional reciprocating tachycardia

c. Management

- Recognize and medically manage the permanent form of junctional reciprocating tachycardia in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)
- Understand the factors associated with electrophysiologic study (eg, indications, contraindications, risks, and limitations) and catheter- or surgical-based ablation therapy for the permanent form of junctional reciprocating tachycardia
- Recognize and manage the consequences of the permanent form of junctional reciprocating tachycardia

10. Antidromic reentry via accessory pathway

a. Clinical recognition

- Recognize the clinical features of antidromic reentry via accessory pathway
- Differentiate antidromic reentry by surface electrocardiographic criteria
- Recognize intracardiac electrophysiologic characteristics of antidromic reentry

b. Basis or cause

- Understand the mechanisms and natural history of antidromic reentry

c. Management

- Recognize and medically manage antidromic reentry in patients of varying ages (eg, fetus, infant, child, adolescent, young adult)

- Understand the factors associated with electrophysiologic study (eg, indications, contraindications, risks, and limitations) and catheter- or surgical-based ablation therapy for antidromic reentry
- Recognize and manage the consequences of antidromic reentry

Accessory AV connection and pre-excitation syndrome

1. Clinical recognition

- Recognize clinical features associated with accessory atrioventricular connection or pre-excitation syndromes
- Recognize associated cardiac defects in a patient with an accessory atrioventricular connection

2. Electrocardiographic diagnosis

- Recognize the ECG features of an atrioventricular connection or pre-excitation syndrome

3. Electrophysiologic diagnosis

- Recognize characteristics of accessory atrioventricular connections or pre-excitation syndromes based on electrophysiologic studies

4. Basis or cause

- Know the natural history of accessory atrioventricular connections or pre-excitation syndromes

5. Management

- Plan the management of patients with accessory atrioventricular connections or pre-excitation syndromes

Ventricular arrhythmias

1. Benign ventricular ectopy

a. Clinical recognition

- Distinguish the clinical features of benign ventricular ectopy and distinguish from more serious ventricular arrhythmias
- Know the risk factors, clinical features, and natural history of benign ventricular ectopy associated with a structurally normal heart or congenital heart disease
- Know the differential diagnosis of benign ventricular ectopy on electrocardiogram
- Identify the specific electrocardiographic features of diseases associated with benign ventricular ectopy

b. Basis or cause

- Understand the mechanisms and natural history of benign ventricular ectopy

c. Management

- Plan the acute and chronic management of benign ventricular ectopy

2. Idiopathic outflow tract ventricular ectopy

a. Clinical recognition

- Distinguish the clinical features of benign idiopathic outflow tract ventricular ectopy
- Know the risk factors, clinical features, and natural history of life-threatening benign idiopathic outflow tract ventricular ectopy associated with a structurally normal heart or congenital heart disease
- Know the differential diagnosis of idiopathic outflow tract ventricular ectopy on electrocardiogram

b. Basis or cause

- Understand the mechanisms and natural history of idiopathic outflow tract ventricular ectopy

c. Management

- Plan the acute and chronic management of idiopathic outflow tract ventricular ectopy and ventricular fibrillation in patients with and without surgery for congenital heart disease

3. Verapamil-sensitive LV septal ventricular tachycardia

a. Clinical recognition

- Distinguish the clinical features of benign verapamil-sensitive LV septal ventricular tachycardia
- Know the risk factors, clinical features, and natural history of life-threatening verapamil-sensitive LV septal ventricular tachycardia associated with a structurally normal heart or congenital heart disease
- Know the differential diagnosis of verapamil-sensitive LV septal ventricular tachycardia on electrocardiogram

b. Basis or cause

- Understand the mechanisms and natural history of verapamil-sensitive LV septal ventricular tachycardia

c. Management

- Plan the acute and chronic management of verapamil-sensitive LV septal ventricular tachycardia in patients with and without surgery for congenital heart disease

4. Scar-related macroreentrant ventricular tachycardia

a. Clinical recognition

- Distinguish the clinical features of scar-related macroreentrant ventricular tachycardia
- Know the risk factors, clinical features, and natural history of life-threatening scar-related macroreentrant ventricular tachycardia associated with a structurally normal heart or congenital heart disease
- Know the differential diagnosis of scar-related macroreentrant ventricular tachycardia on electrocardiogram
- Identify the specific electrocardiographic features of diseases associated with life-threatening scar-related macroreentrant ventricular tachycardia

b. Basis or cause

- Understand the mechanisms and natural history of scar-related macroreentrant ventricular tachycardia

c. Management

- Plan the acute and chronic management of scar-related macroreentrant ventricular tachycardia and ventricular fibrillation in patients with and without surgery for congenital heart disease

5. Ventricular tachycardia in cardiomyopathy

a. Clinical recognition

- Know the risk factors, clinical features, and natural history of life-threatening ventricular tachycardia in cardiomyopathy associated with a structurally normal heart or congenital heart disease
- Know the differential diagnosis of ventricular tachycardia in cardiomyopathy on electrocardiogram

- Identify the specific electrocardiographic features of diseases associated with life-threatening ventricular tachycardia in cardiomyopathy

b. Basis or cause

- Understand the mechanisms and natural history of ventricular tachycardia in cardiomyopathy

c. Management

- Plan the acute and chronic management of ventricular tachycardia in cardiomyopathy in patients with and without surgery for congenital heart disease

6. Catecholaminergic polymorphic ventricular tachycardia

a. Clinical recognition

- Distinguish the clinical features of benign catecholaminergic polymorphic ventricular tachycardia
- Know the risk factors, clinical features, and natural history of life-threatening catecholaminergic polymorphic ventricular tachycardia associated with a structurally normal heart or congenital heart disease
- Know the differential diagnosis of catecholaminergic polymorphic ventricular tachycardia on electrocardiogram
- Identify the specific electrocardiographic features of diseases associated with life-threatening catecholaminergic polymorphic ventricular tachycardia

b. Basis or cause

- Understand the mechanisms and natural history of catecholaminergic polymorphic ventricular tachycardia

c. Management

- Plan the acute and chronic management of catecholaminergic polymorphic ventricular tachycardia in patients with and without surgery for congenital heart disease

7. Arrhythmogenic RV cardiomyopathy

a. Clinical recognition

- Distinguish the clinical features of arrhythmogenic RV cardiomyopathy
- Know the risk factors, clinical features, and natural history of life-threatening benign arrhythmogenic RV cardiomyopathy associated with a structurally normal heart or congenital heart disease
- Know the differential diagnosis of benign arrhythmogenic RV cardiomyopathy on electrocardiogram
- Identify the specific electrocardiographic features of diseases associated with life-threatening right ventricular cardiomyopathy

b. Management

- Plan the acute and chronic management of arrhythmogenic RV cardiomyopathy in patients with and without surgery for congenital heart disease

8. Torsade de pointe ventricular tachycardia

a. Clinical recognition

- Distinguish the clinical features of torsade de pointe ventricular tachycardia
- Know the risk factors, clinical features, and natural history of life-threatening torsade de pointe ventricular tachycardia associated with a structurally normal heart or congenital heart disease
- Know the differential diagnosis of torsade de pointe ventricular tachycardia on electrocardiogram

- Identify the specific electrocardiographic features of diseases associated with life-threatening torsade de pointe ventricular tachycardia

b. Basis or cause

- Understand the mechanisms and natural history of torsade de pointe ventricular tachycardia

c. Management

- Plan the acute and chronic management of torsade de pointe ventricular tachycardia in patients with and without surgery for congenital heart disease

Long QT syndrome and channel abnormalities

1. Clinical recognition

- Recognize and plan appropriate management of long QT interval syndromes and other channel abnormalities (eg, Brugada syndrome, CPMT, ARVD)
- Recognize the association between long QT interval and torsades de pointes

2. Basis or cause

- Recognize the genotypic-phenotypic relationships and identify the genes associated with long QT syndrome and other channel abnormalities
- Recognize the therapeutic implications for the long QT syndrome genotype
- Know the mode of transmission, application, and interpretation of genetic tests of inherited channelopathies

3. Management

- Plan the medical management of arrhythmias of inherited channelopathies
- Understand the indications for implantation of an intracardiac device for inherited channelopathies
- Understand the potential role of cardiac sympathectomy in management of channelopathies

Atrioventricular block

1. Clinical recognition

- Know causes of neonatal complete atrioventricular block (maternal SLE, complex heart disease)
- Recognize clinical manifestations of atrioventricular block

2. Basis or cause

- Know congenital defects associated with atrioventricular block
- Recognize the association of cardiac surgery with atrioventricular block
- Recognize noncardiac diseases associated with atrioventricular block (eg, mitochondrial myopathy, myotonic dystrophy)
- Recognize acquired cardiac diseases associated with atrioventricular block (eg, Lyme disease)
- Know the natural history of atrioventricular block of various causes (eg, congenital, acquired, surgically induced)

3. Management

- Plan appropriate management of atrioventricular block of various causes (eg, congenital, acquired, surgically induced)

Sinus node dysfunction

1. Clinical recognition

- Recognize specific situations involving long QT syndrome and channel abnormalities
- Recognize ECG features of sinus node dysfunction
- Recognize the electrophysiologic abnormalities of sinus node dysfunction
- Identify symptoms associated with sinus node dysfunction

2. Basis or cause a. Recognize the causes of sinus node dysfunction

3. Management a. Know the indication for permanent pacemaker implantation in sinus node dysfunction

Acquired Forms of Cardiac Disease

A. Endocarditis

- Know the risk factors and cardiac and noncardiac lesions that have the highest risk of bacterial endocarditis
- Know the common microorganisms responsible for endocarditis
- Recognize the signs and clinical manifestations of infective endocarditis and the symptoms of bacterial endocarditis resulting in left-heart versus right-heart endocarditis
- Recognize the symptoms of bacterial endocarditis resulting in left-heart versus right-heart endocarditis
- Know the criteria for diagnosing endocarditis
- Identify the extracardiac manifestations and complications of endocarditis and understand their mechanism(s) of development
- Know the indications for surgical management in a patient with endocarditis
- Know the indications for and timing of prophylaxis for bacterial endocarditis

- Know the current status and duration of therapy of antimicrobial therapy of infective endocarditis
- Know the common reasons why endocarditis may yield negative results of a culture
- Plan the management of the complications of endocarditis

B. Myocarditis

- Know the infectious causes of myocarditis
- Know the role of cardiac catheterization and endomyocardial biopsy in diagnosis and management of myocarditis
- Plan appropriate treatment of myocarditis
- Plan appropriate treatment of the cardiac manifestations of Lyme disease
- Formulate the differential diagnosis of an enlarged cardiac silhouette in a febrile child
- Formulate the differential diagnosis of an enlarged, poorly contractile left ventricle
- Understand the natural history of myocarditis
- Know gross and histologic features of major cardiovascular inflammatory disease
- Recognize myocarditis cardiac manifestations of systemic cardiac disease (eg, rheumatoid arthritis, Kawasaki disease, sepsis)
- Recognize the clinical presentation and laboratory features of myocarditis
- Recognize the clinical presentation of viral myocarditis

C. Kawasaki disease

- Know pathologic features and clinical cardiovascular manifestations of Kawasaki disease

- Know the sequence and time of appearance of cardiac lesions associated with Kawasaki disease
- Understand the indications for and the role of diagnostic imaging in initial diagnosis and management of Kawasaki disease, including patients with atypical presentation
- Know the sequence and timing of noncardiac findings associated with Kawasaki disease
- Know current recommendations for drug treatment of acute and chronic Kawasaki disease and results of long-term sequelae

D. Rheumatic fever and rheumatic heart disease

- Epidemiology and disease burden
- Health system challenges
- Understand the etiologic features and specific anatomic features of rheumatic fever and rheumatic heart disease
- Understand diagnostic testing and classification of rheumatic fever
- Know the sequence of anatomic features and natural history of rheumatic fever
- Know the gross and microscopic pathology of rheumatic fever
- Know the effect of pathologic anatomy on physiology in a patient with rheumatic fever
- Recognize the major and minor manifestations of acute rheumatic fever and their significance (eg, carditis, chorea, arthritis etc)
- Know the natural history of valve involvement in rheumatic heart disease and the influence of prophylaxis
- Know how to prevent recurrence of rheumatic fever
- Know the currently recommended drug therapy for a patient with acute rheumatic fever with and without cardiac involvement

- Know the indications for intervention in a patient with rheumatic heart disease

E. Inflammatory heart disease caused by systemic disease

- Recognize the causes and understand treatment of inflammatory heart disease caused by systemic disease

F. Other infectious diseases affecting the heart

- Identify the common cardiac complications of AIDS and know the management of each
- Recognize the cardiac findings secondary to congenital rubella
- Know infectious causes of cardiovascular problems in a newborn infant

G. Cardiac trauma

- Recognize the significance of clinical history and physical examination in the evaluation of cardiovascular complications of cardiac trauma
- Recognize the causes and treatments of commotio cordis
- Know the role of noninvasive testing and laboratory findings in evaluation of cardiac trauma
- Plan appropriate management for a patient having cardiovascular trauma

H. Coronary disease and myocardial ischemia

- Recognize the risk factors for and the precursors to the development of risk factors for coronary artery disease
- Know recommendations for prevention of coronary artery disease, including diagnostic testing and exercise

I. Artificial valves, conduits, and hematologic issues

- Recognize major problems associated with artificial valves and plan appropriate management
- Regulate anticoagulation therapy (warfarin, heparin, low molecular weight heparin) in a patient with an artificial valve or conduit, including management plan at the time of an invasive procedure
- Manage antiplatelet / anticoagulation for noncardiac procedures and conditions
- Understand the effect of damaged endothelium on thrombosis
- Identify clinical and laboratory manifestations of embolic clotting disorders
- Formulate a differential diagnosis in a patient suspected of having an embolic clotting disorder
- Understand the physiology of embolic clotting disorders

Genetic Disorders and Syndromes of the Cardiovascular System

Epidemiology and screening of congenital heart disease

- Know the recurrence risk for the common congenital cardiac anomalies based upon whether the mother or father is affected (parent-of-origin effect)
- Know the recurrence risk for the common congenital cardiac anomalies if a sibling is affected
- Understand appropriate use of genetic testing in unaffected children who have a family history of cardiovascular disease if a first-degree family member is affected
- Understand the appropriate use of genetic testing in children with congenital heart disease and extra-cardiac abnormalities such as intellectual and developmental disability
- Know the major associated cardiac and noncardiac conditions of trisomy 21 and manage their cardiovascular manifestations

- Know the major associated cardiac and noncardiac conditions of trisomy 18 and manage their cardiovascular manifestations
- Know the major associated cardiac and noncardiac conditions of trisomy 13 and manage their cardiovascular manifestations
- Recognize the clinical signs and symptoms of the cardiovascular manifestations of monosomy X (Turner syndrome) and manage their cardiovascular manifestations
- Recognize and diagnose Noonan syndrome and manage its cardiac manifestations
- Recognize and diagnose Holt Oram syndrome and its molecular pathogenesis
- Recognize and diagnose LEOPARD syndrome and manage its cardiac manifestations
- Recognize and diagnose Kartagener (dysmotile cilia) syndrome and manage its cardiac manifestations
- Recognize and diagnose CHARGE association and manage its cardiovascular manifestations
- Recognize and diagnose Barth syndrome and manage its cardiovascular manifestations
- Recognize and diagnose VATER association and manage its cardiovascular manifestations
- Recognize and diagnose Williams syndrome and manage its cardiac manifestations
- Recognize and diagnose the cardiac manifestations of Rubinstein-Taybi syndrome and manage its cardiac manifestations
- Recognize and diagnose Alagille syndrome and manage its cardiac manifestations
- Recognize and diagnose syndromes with chromosome 22q11 deletion and manage their cardiovascular manifestations
- Recognize and diagnose Ellis-van Creveld syndrome and manage its cardiac manifestations

Connective tissue diseases (including Marfan syndrome)

- Recognize cardiovascular involvement in a patient with collagen vascular disease and plan appropriate management
- Recognize and diagnose Marfan and related syndromes (eg, Loeys-Dietz syndrome, congenital contractural arachnodactyly) and manage their cardiovascular manifestations
- Recognize and diagnose the cardiovascular manifestations of the classical and vascular forms of Ehlers-Danlos syndrome and manage their cardiovascular manifestations
- Recognize and diagnose hereditary hemorrhagic telangiectasia (Osler-Rendu-Weber syndrome)

Hematologic diseases

- Recognize and manage the cardiovascular manifestations of sickle cell disease
- Recognize and diagnose thalassemia syndromes and manage their cardiovascular manifestations

Tuberous sclerosis and neurofibromatosis

- Recognize and diagnose tuberous sclerosis and manage its cardiovascular manifestations
- Recognize and diagnose neurofibromatosis and manage its cardiovascular manifestations

Familial atrial myxoma

- Recognize and diagnose familial atrial myxoma and manage its cardiovascular manifestations

Congenital Heart Disease in the Adolescent and Adult

A. Transitional care

- Understand the importance of transitional education and timing
- Be able to inform patients regarding health care insurance issues related to their disease
- Be able to advise patients to regarding access to their medical records during transition
- Be able to advise patients regarding family planning issues

Pregnancy

- Know how to counsel an adolescent/adult with congenital heart disease regarding contraception and pregnancy
- Know the cardiovascular conditions that increase risk and those that are contraindications to pregnancy
- Know how to manage cardiac aspects of pregnancy
- Manage artificial valves during pregnancy

Cardiac risk of long-standing systemic disease

- Recognize and manage chronic cyanosis in a patient with pulmonary vascular obstructive disease
- Recognize the changes in arrhythmia risk as patients with CHD age, and understand the basic principles of risk stratification

Collateral disease associated with long-standing CHD

- Recognize and be able to treat collateral disease associated with long-standing CHD

Psychosocial issues

- Understand appropriate employment settings for an adolescent/young adult with cardiovascular disease

- Identify risk-taking behaviors with magnified negative consequences in an adolescent/young adult with cardiovascular disease Preventive cardiology

Core Knowledge in Scholarly Activities

A. Principles of use of biostatistics in research

1. Types of variables

- Distinguish types of variables (eg, continuous, categorical, ordinal, nominal)
- Understand how the type of variable (eg, continuous, categorical, nominal) affects the choice of statistical test

2. Distribution of data

- Understand how distribution of data affects the choice of statistical test
- Differentiate normal from skewed distribution of data
- Understand the appropriate use of the mean, median, and mode
- Understand the appropriate use of standard deviation
- Understand the appropriate use of standard error

3. Hypothesis testing

- Distinguish the null hypothesis from an alternative hypothesis
- Interpret the results of hypothesis testing

4. Statistical tests

- Understand the appropriate use of the chi-square test versus a t-test
- Understand the appropriate use of analysis of variance (ANOVA)
- Understand the appropriate use of parametric (eg, t-test, ANOVA) versus non-parametric (eg, Mann-Whitney U, Wilcoxon) statistical tests
- Interpret the results of chi-square tests

- Interpret the results of t-tests
- Understand the appropriate use of a paired and non-paired t-test
- Determine the appropriate use of a 1- versus 2-tailed test of significance
- Interpret a p-value
- Interpret a p-value when multiple comparisons have been made
- Interpret a confidence interval
- Identify a type I error
- Identify a type II error

5. Measurement of association

- Differentiate relative risk reduction from absolute risk reduction
- Calculate and interpret a relative risk
- Calculate and interpret an odds ratio
- Interpret a hazard ratio
- Understand the uses and limitations of a correlation coefficient

6. Regression

- Identify when to apply regression analysis (eg, linear, logistic)
- Interpret a regression analysis (eg, linear, logistic)
- Identify when to apply survival analysis (eg, Kaplan-Meier)
- Interpret a survival analysis (eg, Kaplan-Meier)

7. Diagnostic tests

- Recognize the importance of an independent "gold standard" in evaluating a diagnostic test
- Calculate and interpret sensitivity and specificity
- Calculate and interpret positive and negative predictive values
- Understand how disease prevalence affects the positive and negative predictive value of a test

- Calculate and interpret likelihood ratios
- Interpret a receiver operator characteristic curve
- Interpret and apply a clinical prediction rule
- Systematic reviews and meta-analysis
- Understand the purpose of a systematic review
- Understand the advantages of adding a meta-analysis to a systematic review
- Interpret the results of a meta-analysis
- Identify the limitations of a systematic review
- Identify the limitations of a meta-analysis

B. Principles of epidemiology and clinical research design

1. Study types

- Distinguish between Phase I, II, III, and IV clinical trials
- Recognize a retrospective study
- Understand the strengths and limitations of retrospective studies
- Recognize a case series
- Understand the strengths and limitations of case series
- Recognize a cross-sectional study
- Understand the strengths and limitations of cross-sectional studies
- Recognize a case-control study
- Understand the strengths and limitations of case-control studies
- Recognize a longitudinal study
- Understand the strengths and limitations of longitudinal studies
- Recognize a cohort study
- Understand the strengths and limitations of cohort studies
- Recognize a randomized-controlled study
- Understand the strengths and limitations of randomized-controlled studies
- Recognize a before-after study

- Understand the strengths and limitations of before-after studies
- Recognize a crossover study
- Understand the strengths and limitations of crossover studies
- Recognize an open-label study
- Understand the strengths and limitations of open-label studies
- Recognize a post-hoc analysis
- Understand the strengths and limitations of post-hoc analyses
- Recognize a subgroup analysis
- Understand the strengths and limitations of subgroup analyses

2. Bias and confounding

- Understand how bias affects the validity of results
- Understand how confounding affects the validity of results
- Identify common strategies in study design to avoid or reduce bias
- Identify common strategies in study design to avoid or reduce confounding
- Understand how study results may differ between distinct sub- populations (effect modification)

3. Causation

- Understand the difference between association and causation
- Identify factors that strengthen causal inference in observational studies (eg, temporal sequence, dose response, repetition in a different population, consistency with other studies, biologic plausibility)

4. Incidence and prevalence

- Distinguish disease incidence from disease prevalence

5. Screening

- Understand factors that affect the rationale for screening for a condition or disease (eg, prevalence, test accuracy, risk-benefit, disease burden, presence of a presymptomatic state)

6. Decision analysis

- Understand the strengths and limitations of decision analyses
- Interpret a decision analysis

7. Cost-benefit, cost-effectiveness, and outcomes

- Differentiate cost-benefit from cost-effectiveness analysis
- Understand how quality-adjusted life years are used in cost analyses
- Understand the multiple perspectives (eg, of an individual, payor, society) that influence interpretation of cost-benefit and cost-effectiveness analyses

8. Sensitivity analysis

- Understand the strengths and limitations of sensitivity analysis
- Interpret the results of sensitivity analysis

9. Measurement

- Understand the types of validity that relate to measurement (eg, face, construct, criterion, predictive, content)
- Distinguish validity from reliability
- Distinguish internal from external validity
- Distinguish accuracy from precision
- Understand and interpret measurements of interobserver reliability (eg, kappa)
- Understand and interpret Cronbach alpha

Applying research to clinical practice

1. Assessment of study design, performance, and analysis (internal validity)

- Recognize when appropriate control groups have been selected for a case-control study
- Recognize when appropriate control groups have been selected for a cohort study
- Recognize the use and limitations of surrogate endpoints
- Understand the use of intent-to-treat analysis
- Understand how sample size affects the power of a study
- Understand how sample size may limit the ability to detect adverse events
- Understand how to calculate an adequate sample size for a controlled trial (eg, clinically meaningful difference, variability in measurement, choice of alpha and beta)

2. Assessment of generalizability (external validity)

- Identify factors that contribute to or jeopardize generalizability
- Understand how non-representative samples can bias results
- Assess how the data source (eg, diaries, billing data, discharge diagnostic code) may affect study results

3. Application of information for patient care

- Estimate the post-test probability of a disease, given the pretest probability of the disease and the likelihood ratio for the test
- Calculate absolute risk reduction
- Calculate and interpret the number-needed-to-treat
- Distinguish statistical significance from clinical importance

4. Using the medical literature

- Given the need for specific clinical information, identify a clear, structured, searchable clinical question
- Identify the study design most likely to yield valid information about the accuracy of a diagnostic test
- Identify the study design most likely to yield valid information about the benefits and/or harms of an intervention
- Identify the study design most likely to yield valid information about the prognosis of a condition

Principles of teaching and learning

1. Educational theory

- Understand the basic principles of adult learning theory (eg, adult learners are self-directed, goal-oriented, practical; need to feel respected, build on life experiences; learn best when learning is based on an existing framework)
- Understand the attributes of an effective learning environment
- Understand the importance of "reflective practice" in teaching and learning
- Identify strategies that motivate learners
- Recognize the impact of the "hidden curriculum" on learning

2. Feedback and evaluation

- Identify components of effective feedback
- Distinguish between formative and summative feedback
- Distinguish between evaluation and feedback

- Understand the strengths and weaknesses of various methods to evaluate learners

3. Teaching methods

- Understand the strengths and weaknesses of various teaching methods (eg, lecture, small group discussion, bedside teaching, simulation)
- Understand that individuals may learn more effectively with certain teaching methods (eg, reading, hearing, doing) than with others

4. Educational planning

- Understand the role of needs assessment in educational planning
- Distinguish between goals and learning objectives
- Identify components of well-formulated learning objectives
- Recognize the strengths and weaknesses of various educational outcome measures (eg, participant satisfaction, acquisition of knowledge and skills, behavioral change, patient outcomes)

Ethics in research

1. Conflicts of interest and commitment

- Evaluate whether an investigator has a conflict of interest during the course of a study
- Understand ways to manage a conflict of interest
- Understand what constitutes a conflict of commitment

2. Professionalism and misconduct in research

- Identify forms of research misconduct (eg, plagiarism, fabrication, falsification)
- Differentiate honest error and differences of opinion from research misconduct
- Understand the criteria for authorship of clinical research publications

3. Principles of research with human subjects

- Understand and apply the three main principles of research ethics articulated in the Belmont Report (eg, respect for persons, beneficence, and justice)
- Understand the role of analysis of risks and benefits in the ethical conduct of research
- Understand the federal regulatory definitions regarding which activities are considered research
- Understand the federal regulatory definitions regarding when research includes the use of human subjects
- Understand the federal regulatory definition of minimal risk
- Understand the functions of an Institutional Review Board
- Understand when an exemption from review by the Institutional Review Board is permissible
- Understand the functions of a Data Safety Monitoring Board
- Understand the importance of clinical equipoise in research with human subjects
- Understand the impact of "therapeutic misconception" on clinical research with human subjects
- Understand the ethical considerations of study design (eg, placebo, harm of intervention, deception, flawed design)

4. Principles of consent and assent

- Understand what constitutes informed consent in research
- Understand how undue influence can affect obtaining consent for research
- Understand how coercion can affect obtaining consent for research
- Understand the special ethical considerations related to research utilizing children because of their inability to give informed consent
- Distinguish among consent, assent, and permission in research involving children

5. Vulnerable populations

- Recognize that the definition of "children" is related to the underlying clinical intervention in the jurisdiction in which the child is located rather than a fixed nationwide notion of age
- Recognize the types of protections that might be accorded to vulnerable populations (eg, incarcerated individuals, pregnant women, fetuses, children, mentally disabled individuals, educationally or economically disadvantaged individuals)
- Understand the concept of minimal risk as it applies to research involving children
- Understand the circumstances under which research that involves children and that entails greater than minimal risk may be permissible

Biostatistics, Research Methodology and Clinical Epidemiology

Ethics

Medico legal aspects relevant to the discipline

Health Policy issues as may be applicable to the discipline

Competencies

- Be able to perform a reliable and appropriate examination
- Be able to examine children in an appropriate manner
- Behaviours Respect patients' dignity and confidentiality
- Acknowledge cultural issues
- Involve relatives appropriately
- Appreciate the need for a chaperone

THESIS PROTOCOL & THESIS

The candidates are required to submit a thesis at the end of three years of training as per the rules and regulations of NBE.

Guidelines for Submission of Thesis Protocol & Thesis by candidates

Research shall form an integral part of the education programme of all candidates registered for DNB degrees of NBE. The Basic aim of requiring the candidates to write a thesis protocol & thesis/dissertation is to familiarize him/her with research methodology. The members of the faculty guiding the thesis/dissertation work for the candidate shall ensure that the subject matter selected for the thesis/dissertation is **feasible, economical and original**.

Guidelines for Thesis Protocol

The protocol for a research proposal (including thesis) is a study plan, designed to describe the background, research question, aim and objectives, and detailed methodology of the study. In other words, the protocol is the 'operating manual' to refer to while conducting a particular study.

The candidate should refer to the NBE Guidelines for preparation and submission of Thesis Protocol before the writing phase commences. The minimum writing requirements are that the language should be clear, concise, precise and consistent without excessive adjectives or adverbs and long sentences. There should not be any redundancy in the presentation.

The development or preparation of the Thesis Protocol by the candidate will help her/him in understanding the ongoing activities in the proposed area of research. Further it helps in creating practical exposure to research and hence it bridges the connectivity between clinical practice and biomedical research. Such research exposure will be helpful in improving problem solving capacity, getting updated with ongoing research and implementing these findings in clinical practice.

Research Ethics: Ethical conduct during the conduct and publication of research is an essential requirement for all candidates and guides, with the primary responsibility of ensuring such conduct being on the thesis guide. Issues like Plagiarism, not maintaining the confidentiality of data, or any other distortion of the research process will be viewed seriously. The readers may refer to standard documents for the purpose.

The NBE reserves the right to check the submitted protocol for plagiarism, and will reject those having substantial duplication with published literature.

PROTOCOL REQUIREMENTS

1. All of the following will have to be entered in the online template. The thesis protocol should be restricted to the following word limits.
 - Title : 120 characters (with spacing) page
 - Synopsis [structured] : 250-300
 - Introduction : 300-500
 - Review of literature : 800-1000
 - Aim and Objectives : Up to 200
 - Material and Methods : 1200-1600
 - 10-25 References [ICMJE style]
2. It is mandatory to have ethics committee approval before initiation of the research work. The researcher should submit an appropriate application to the ethics committee in the prescribed format of the ethics committee concerned.

Guidelines for Thesis

1. The proposed study must be approved by the institutional ethics committee and the protocol of thesis should have been approved by NBE.
2. The thesis should be restricted to the size of 80 pages (maximum). This includes the text, figures, references, annexures, and certificates etc. It should be printed on both sides of the paper; and every page has to be numbered. Do not leave any page blank. To achieve this, following points may be kept in view:
 - a. The thesis should be typed in 1.5 space using Times New Roman/Arial/ Garamond size 12 font, 1” margins should be left on all four sides. Major sections viz., Introduction, Review of Literature, Aim & Objectives, Material and Methods, Results, Discussion, References, and Appendices should start from a new page. Study proforma (Case record form), informed consent form, and patient information sheet may be printed in single space.
 - b. Only contemporary and relevant literature may be reviewed. Restrict the introduction to 2 pages, Review of literature to 10-12 pages, and Discussion to 8-10 pages.
 - c. The techniques may not be described in detail unless any modification/innovations of the standard techniques are used and reference(s) may be given.
 - d. Illustrative material may be restricted. It should be printed on paper only. There is no need to paste photographs separately.

3. Since most of the difficulties faced by the residents relate to the work in clinical subject or clinically-oriented laboratory subjects, the following steps are suggested:
 - a. The number of cases should be such that adequate material, judged from the hospital attendance/records, will be available and the candidate will be able to collect case material within the period of data collection, i.e., around 6-12 months so that he/she is in a position to complete the work within the stipulated time.
 - b. The aim and objectives of the study should be well defined.
 - c. As far as possible, only clinical/laboratory data of investigations of patients or such other material easily accessible in the existing facilities should be used for the study.
 - d. Technical assistance, wherever necessary, may be provided by the department concerned. The resident of one specialty taking up some problem related to some other specialty should have some basic knowledge about the subject and he/she should be able to perform the investigations independently, wherever some specialized laboratory investigations are required a co-guide may be co-opted from the concerned investigative department, the quantum of laboratory work to be carried out by the candidate should be decided by the guide & co-guide by mutual consultation.
4. The clinical residents are not ordinarily expected to undertake experimental work or clinical work involving new techniques, not hitherto perfected OR the use of chemicals or radioisotopes not readily available. They should; however, be free to enlarge the scope of their studies or undertake experimental work on their own initiative but all such studies should be feasible within the existing facilities.
5. The DNB residents should be able to freely use the surgical pathology/autopsy data if it is restricted to diagnosis only, if however, detailed historic data are required the resident will have to study the cases himself with the help of the guide/co-guide. The same will apply in case of clinical data.
6. Statistical methods used for analysis should be described specifically for each objective, and name of the statistical program used mentioned.

General Layout of a DNB Thesis:

- **Title-** A good title should be brief, clear, and focus on the central theme of the topic; it should avoid abbreviations. The Title should effectively summarize the proposed research and should contain the PICO elements.

- **Introduction-** It should be focused on the research question and should be directly relevant to the objectives of your study.
- **Review of Literature** - The Review should include a description of the most relevant and recent studies published on the subject.
- **Aim and Objectives** - The 'Aim' refers to what would be broadly achieved by this study or how this study would address a bigger question / issue. The 'Objectives' of the research stem from the research question formulated and should at least include participants, intervention, evaluation, design.
- **Material and Methods-** This section should include the following 10 elements: Study setting (area), Study duration; Study design (descriptive, case-control, cohort, diagnostic accuracy, experimental (randomized/non-randomized)); Study sample (inclusion/exclusion criteria, method of selection), Intervention, if any, Data collection, Outcome measures (primary and secondary), Sample size, Data management and Statistical analysis, and Ethical issues (Ethical clearance, Informed consent, trial registration).
- **Results-** Results should be organized in readily identifiable sections having correct analysis of data and presented in appropriate charts, tables, graphs and diagram etc.
- **Discussion**—It should start by summarizing the results for primary and secondary objectives in text form (without giving data). This should be followed by a comparison of your results on the outcome variables (both primary and secondary) with those of earlier research studies.
- **Summary and Conclusion-** This should be a précis of the findings of the thesis, arranged in four paragraphs: (a) background and objectives; (b) methods; (c) results; and (d) conclusions. The conclusions should strictly pertain to the findings of the thesis and not outside its domain.
- **References-** Relevant References should be cited in the text of the protocol (in superscripts).
- **Appendices** -The tools used for data collection such as questionnaire, interview schedules, observation checklists, informed consent form (ICF), and participant information sheet (PIS) should be attached as appendices. Do not attach the master chart.

Thesis Protocol Submission to NBE

1. DNB candidates are required to submit their thesis protocol within 90 days of their joining DNB training.
2. Enclosures to be submitted along with protocol submission form:
 - a) Form for Thesis Protocol Submission properly filled.
 - b) Thesis Protocol duly signed.
 - c) Approval letter of institutional Ethical committee. (*Mandatory, non receivable of any one is liable for rejection*)

Thesis Submission to NBE

1. As per NBE norms, writing a thesis is essential for all DNB candidates towards partial fulfillment of eligibility for award of DNB degree.
2. DNB candidates are required to submit the thesis before the cut-off date which shall be 30th June of the same year for candidates appearing for their scheduled December final theory examination. Similarly, candidates who are appearing in their scheduled June DNB final examination shall be required to submit their thesis by 31st December of preceding year.
3. Candidates who fail to submit their thesis by the prescribed cutoff date shall NOT be allowed to appear in DNB final examination.
4. Fee to be submitted for assessment (In INR): 3500/-
5. Fee can be deposited ONLY through pay-in-slip/challan at any of the Indian bank branch across India. The challan can be downloaded from NBE website www.natboard.edu.in
6. Thesis should be bound and the front cover page should be printed in the standard format. A bound thesis should be accompanied with:
 - a. A Synopsis of thesis.
 - b. Form for submission of thesis, duly completed
 - c. NBE copy of challan (in original) towards payment of fee as may be applicable.
 - d. Soft copy of thesis in a CD duly labeled.
 - e. Copy of letter of registration with NBE.
7. A declaration of thesis work being bonafide in nature and done by the candidate himself/herself at the institute of DNB training need to be submitted bound with thesis. It must be signed by the candidate himself/herself, the thesis guide and head of the institution, failing which thesis shall not be considered.

The detailed guidelines and forms for submission of Thesis

Protocol & Thesis are available at

www.natboard.edu.in.thesis.php

LOG BOOK

A candidate shall maintain a log book of operations (assisted / performed) during the training period, certified by the concerned post graduate teacher / Head of the department / senior consultant.

This log book shall be made available to the board of examiners for their perusal at the time of the final examination.

The log book should show evidence that the before mentioned subjects were covered (with dates and the name of teacher(s)) The candidate will maintain the record of all academic activities undertaken by him/her in log book .

1. Personal profile of the candidate
2. Educational qualification/Professional data
3. Record of case histories
4. Procedures learnt
5. Record of case Demonstration/Presentations
6. Every candidate, at the time of practical examination, will be required to produce performance record (log book) containing details of the work done by him/her during the entire period of training as per requirements of the log book. It should be duly certified by the supervisor as work done by the candidate and countersigned by the administrative Head of the Institution.
7. In the absence of production of log book, the result will not be declared.

Leave Rules

1. DNB Trainees are entitled to leave during the course of DNB training as per the Leave Rules prescribed by NBE.
2. A DNB candidate can avail a maximum of 20 days of leave in a year excluding regular duty off/ Gazetted holidays as per hospital/institute calendar/policy.
3. MATERNITYLEAVE:
 - a. A female candidate is permitted a maternity leave of 90 days once during the entire duration of DNB course.
 - b. The expected date of delivery (EDD) should fall within the duration of maternity leave.
 - c. Extension of maternity leave is permissible only for genuine medical reasons and after prior approval of NBE. The supporting medical documents have to be certified by the Head of the Institute/hospital where the candidate is undergoing DNB training. NBE reserves its rights to take a final decision in such matters.
 - d. The training of the candidate shall be extended accordingly in case of any extension of maternity leave being granted to the candidate.
 - e. Candidate shall be paid stipend during the period of maternity leave. No stipend shall be paid for the period of extension of leave.
4. Male DNB candidates are entitled for paternity leave of maximum of one week during the entire period of DNB training.
5. No kind of study leave is permissible to DNB candidates. However, candidates may be allowed an academic leave as under across the entire duration of training program to attend the conferences/CMEs/Academic programs/Examination purposes.

DNB COURSE	NO. OF ACADEMIC LEAVE
DNB 3 years Course (Broad & Super Specialty)	14 Days
DNB 2 years Course (Post Diploma)	10 Days
DNB Direct 6 years Course	28 days

6. Under normal circumstances leave of one year should not be carried forward to the next year. However, in exceptional cases such as prolonged illness the leave across the DNB training program may be clubbed together with prior approval of NBE.
7. Any other leave which is beyond the above stated leave is not permissible and shall lead to extension/cancellation of DNB course.
8. Any extension of DNB training for more than 2 months beyond the scheduled completion date of training is permissible only under extraordinary circumstances with prior approval of NBE. Such extension is neither automatic nor shall be granted as a matter of routine. NBE shall consider such requests on merit provided the seat is not carried over and compromise with training of existing trainees in the Department.
9. Unauthorized absence from DNB training for more than 7 days may lead to cancellation of registration and discontinuation of the DNB training and rejoining shall not be permitted.

10. Medical Leave

- a. Leave on medical grounds is permissible only for genuine medical reasons and NBE should be informed by the concerned institute/hospital about the same immediately after the candidate proceeds on leave on medical grounds.
- b. The supporting medical documents have to be certified by the Head of the Institute/hospital where the candidate is undergoing DNB training and have to be sent to NBE.
- c. The medical treatment should be taken from the institute/ hospital where the candidate is undergoing DNB training. Any deviation from this shall be supported with valid grounds and documentation.
- d. In case of medical treatment being sought from some other institute/hospital, the medical documents have to be certified by the Head of the institute/hospital where the candidate is undergoing DNB training.

- e. NBE reserves its rights to verify the authenticity of the documents furnished by the candidate and the institute/hospital regarding Medical illness of the candidate and to take a final decision in such matters.

11.

- a. Total leave period which can be availed by DNB candidates is $120+28 = 148$ days for 6 years course, $60+14=74$ days for 3 years course and $40+10 = 50$ days for 2 years course. This includes all kinds of eligible leave including academic leave. Maternity / Paternity leave can be availed separately by eligible candidates. Any kind of leave including medical leave exceeding the aforementioned limit shall lead to extension of DNB training. It is clarified that prior approval of NBE is necessary for availing any such leave.
- b. The eligibility for DNB Final Examination shall be determined strictly in accordance with the criteria prescribed in the respective information bulletin.

EXAMINATION

FORMATIVE ASSESSMENT

Formative assessment includes various formal and informal assessment procedures by which evaluation of student's learning, comprehension, and academic progress is done by the teachers/ faculty to improve student attainment. Formative assessment test (FAT) is called as "Formative" as it informs the in process teaching and learning modifications. FAT is an integral part of the effective teaching. The goal of the FAT is to collect information which can be used to improve the student learning process.

Formative assessment is essentially positive in intent, directed towards promoting learning; it is therefore part of teaching. Validity and usefulness are paramount in formative assessment and should take precedence over concerns for reliability. The assessment scheme consists of Three Parts which has to be essentially completed by the candidates.

The scheme includes:-

Part I:- Conduction of theory examination

Part-II :- Feedback session on the theory performance

Part-III :- Work place based clinical assessment

Scheme of Formative assessment

PART – I	CONDUCT OF THEORY EXAMINATION	Candidate has to appear for Theory Exam and it will be held for One day.
PART – II	FEEDBACK SESSION ON THE THEORY PERFORMANCE	Candidate has to appear for his/her Theory Exam Assessment Workshop.
PART – III	WORK PLACE BASED CLINICAL ASSESSMENT	After Theory Examination, Candidate has to appear for Clinical Assessment.

The performance of the resident during the training period should be monitored throughout the course and duly recorded in the log books as evidence of the ability and daily work of the student

1. Personal attributes:

- **Behavior and Emotional Stability:** Dependable, disciplined, dedicated, stable in emergency situations, shows positive approach.
- **Motivation and Initiative:** Takes on responsibility, innovative, enterprising, does not shirk duties or leave any work pending.

- **Honesty and Integrity:** Truthful, admits mistakes, does not cook up information, has ethical conduct, exhibits good moral values, loyal to the institution.
- **Interpersonal Skills and Leadership Quality:** Has compassionate attitude towards patients and attendants, gets on well with colleagues and paramedical staff, is respectful to seniors, has good communication skills.

2. Clinical Work:

- **Availability:** Punctual, available continuously on duty, responds promptly on calls and takes proper permission for leave.
- **Diligence:** Dedicated, hardworking, does not shirk duties, leaves no work pending, does not sit idle, competent in clinical case work up and management.
- **Academic ability:** Intelligent, shows sound knowledge and skills, participates adequately in academic activities, and performs well in oral presentation and departmental tests.
- **Clinical Performance:** Proficient in clinical presentations and case discussion during rounds and OPD work up. Preparing Documents of the case history/examination and progress notes in the file (daily notes, round discussion, investigations and management) Skill of performing bed side procedures and handling emergencies.

3. Academic Activity: Performance during presentation at Journal club/ Seminar/ Case discussion/Stat meeting and other academic sessions. Proficiency in skills as mentioned in job responsibilities.

FINAL EXAMINATION

The summative assessment of competence will be done in the form of DNB Final Examination leading to the award of the degree of Diplomate of National Board in Emergency Medicine. The DNB final is a two-stage examination comprising the theory and practical part. An eligible candidate who has qualified the theory exam is permitted to appear in the practical examination.

Theory Examination

1. The theory examination comprises of **Three/ Four** papers, maximum marks 100 each.
2. There are 10 short notes of 10 marks each, in each of the papers. The number of short notes and their respective marks weightage may vary in some subjects/some papers.
3. Maximum time permitted is 3 hours.

4. Candidate must score at least 50% in the aggregate of **Three/ Four** papers to qualify the theory examination.
5. Candidates who have qualified the theory examination are permitted to take up the practical examination.
6. The distribution of the Theory Examination shall be as follows:

Paper I
Paper II
Paper III
Paper IV

a) Practical Examination:

1. Maximum Marks: 300.
2. Comprises of Clinical Examination and Viva.
3. Candidate must obtain a minimum of 50% marks in the Clinical Examination (including Viva) to qualify for the Practical Examination.
4. There are a maximum of three attempts that can be availed by a candidate for Practical Examination.
5. First attempt is the practical examination following immediately after the declaration of theory results.
6. Second and Third attempt in practical examination shall be permitted out of the next three sessions of practical examinations placed alongwith the next three successive theory examination sessions; after payment of full examination fees as may be prescribed by NBE.
7. Absentation from Practical Examination is counted as an attempt.
8. Appearance in first practical examination is compulsory;
9. Requests for Change in center of examination are not entertained, as the same is not permissible.
10. Candidates are required not to canvass with NBE for above.

Declaration of DNB Final Results

1. DNB final is a qualifying examination.
2. Results of DNB final examinations (theory & practical) are declared as PASS/FAIL.
3. DNB degree is awarded to a DNB trainee in the convocation of NBE.

RECOMMENDED TEXT BOOKS AND JOURNALS

BOOKS

- Moss & Adams' Heart Disease in Infants, Children, and Adolescents: Including the Fetus and Young Adult
- Pediatric Cardiology - Springer
- Nadas' Pediatric Cardiology -
- Pediatric Cardiology and Cardiovascular Surgery:
- Elsevier: Park's The Pediatric Cardiology Handbook, 5th Edition: Park
- How to Read Pediatric ECGs - 9780323035705 | US Elsevier Health
- Fundamentals of Pediatric Cardiology: David J Driscoll MD
- Pediatric Cardiovascular Medicine, 2nd Edition
- James H. Moller (Editor), Julien I. E. Hoffman (Editor)
- Concise Guide to Pediatric Arrhythmias by Christopher Wren
- Pediatric Cardiology Board Review, 2e *By Benjamin W. Eidem, Bryan C. Cannon, Anthony C. Chang, Frank Cetta and Jonathan N. Johnson*
- Practical Pediatric Cardiology
- Case-Based Management of Potential Pitfalls
- Editors: Magee, Alan G., Till, Jan, Seale, Anna N. (Eds.)
- Pediatric and Congenital Cardiology, Cardiac Surgery and Intensive Care
- Editors: da Cruz, Eduardo, Ivy, Dunbar, Jaggars, James (Ed
- IAP Specialty Series on Pediatric Cardiology

- Pediatric Practice: Cardiology
- Marie Murphy Gleason, Jack Rychik, Robert Shaddy
- Pediatric Cardiology: Requisites (Requisites in Pediatrics) 1st Edition
by Victoria L. Vetter
- Echocardiography in Pediatric and Congenital Heart Disease: From Fetus to Adult, 2nd Edition
- Wyman W. Lai, Luc L. Mertens, Meryl S. Cohen, Tal Geva
- Pediatric ECG Interpretation: An Illustrative Guide
- Barbara J. Deal, M.D., Christopher L. Johnsrude, M.D., Scott H. Buck, M.D.
- Congenital Diseases of the Heart: Clinical-Physiological Considerations, 3rd Edition
- Abraham Rudolph
- Illustrated FIELD GUIDE to Congenital Heart Disease and Repair
- Fundamentals of Pediatric Cardiology David J Driscoll MD
- *By Allen D. Everett and D. Scott Lim, MD New*
- Insight in Pediatric Cardiology: From Basic to Therapeutics by
Giuseppe Santoro, Giuseppe Pacileo, Maria Giovanna Russo
- The Science and Practice of Pediatric Cardiology Hardcover – Import, 1
Jan 1998 by Arthur Garson (Editor), etc. (Editor), Jonathan Pin
- Manual of Pediatric Cardiac Intensive Care – 2012 by Luthra (Author)

JOURNALS

- Pediatric Cardiology
- Progress in Pediatric Cardiology
- Annals of Pediatric Cardiology
- Cardiology in the Young | Cambridge Core
- Congenital Heart Disease and Pediatric Cardiology
- Progress in Pediatric Cardiology World Journal for Pediatric and Congenital Heart Surgery
