Curricula components for entrustable professional activities for the subspecialty of pediatric cardiology

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Entrustable professional activities (EPAs) for the subspecialty of pediatric cardiology were defined and developed by the task force committee for revised training guidelines chaired by Dr. Robert Ross in 2015 [1]. These were subsequently vetted, approved and published by the American Board of Pediatrics (ABP) and Council of Pediatric Subspecialties (CoPS) [2,3]. The EPA framework complements the competency/milestone framework and their integration provides a more comprehensive perspective on learner performance. While competencies and their milestones focus on abilities, EPAs focus on outcomes of a care delivery encounter and thus require an integration of competencies. The EPAs also provide a clinical context in which to assess competencies and milestones, which makes assessment more focused and specific. The word “entrustable” refers to the ability to safely and effectively perform the EPA without supervision, bringing the perspective of level of needed supervision into the assessment of trainees [4,5].

For pediatric cardiology the subspecialty-specific professional activities defined are as follows:

- Diagnosis and management of patients with arrhythmias and conduction abnormalities.
- Caring for patients who require catheter based interventions.
- Diagnosis, initial management, and referral of children with advanced or end stage heart failure and/or pulmonary hypertension to experts for medical therapy, ECMO, ventricular assist device and/or cardiac transplantation.
- Diagnosis and management of patients with congenital or acquired cardiac problems.
- Diagnosis and management of patients with acute congenital or acquired cardiac problems requiring intensive care.
- Application of the imaging skills required for all aspects of pediatric and congenital cardiology care.

In order for the faculty to assess the level of supervision required for trainees in each of these activities, the training program has to provide a curriculum and a training environment that would allow for direct observation and assessment of these skills, behaviors, attributes and knowledge.

The curriculum for training was published in 2015 and these documents align with those published guidelines [1]. The ABP enlisted support from SPCTPD to develop curricular components for the cardiology specific EPAs. The term curricular components rather than curriculum was chosen to limit the breadth of work to include: 1) the knowledge and skills needed to support the functions of the given EPA and 2) scope of practice, focusing on types of patients that are typically cared for by the subspecialist based on both importance and prevalence of the illness. Equally important are the suggestions for referral and co-management, noting that practice context greatly affects referral patterns.

We thank the members of our community who reviewed the curricular components and provided valuable feedback.
Curricular Components for Cardiology EPA

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References

1. http://pediatrics.aappublications.org/content/135/6/e1536
2. https://www.abp.org/subspecialty-epas#Cardiology
3. http://www.peds subs.org/issues/EPAs_Cardiology.cfm
5. The Referral and Consultation Entrustable Professional Activity: Defining the Components in Order to Develop a Curriculum for Pediatric Residents, Ellen K. Hamburger, MD, Lindsey Lane, BM, BCH; Dewesh Agrawal, MD; Claire Boogaard, MD; Janice L. Hanson, PhD; Jessica Weisz, MD; Mary Ottolini, MD, MPH. ACADEMIC PEDIATRICS 2016;15:5–8

2. Description of the Activity

Upon completion of a general pediatric cardiology fellowship, the individual must be able to diagnose and treat basic arrhythmias and conduction disorders which can be seen in both the child with congenital heart disease and the child with a structurally normal heart.

The specific functions which define this EPA include:
- Obtaining essential information and testing
- Knowing the underlying mechanisms of cardiac electrical conduction/rhythm generation and indications for electrocardiography (ECG), Exercise testing, Holter monitoring, and event recording as well as knowing the basics of invasive EP.
- Performing an ECG, Holter recording, Exercise test or event recording.
- Interpreting ECGs, exercise testing, Holter monitoring and event recording, along with clinical integration of basic invasive EP data and aligning with comprehensive differential diagnoses
- Treating electrical abnormalities and knowing when to consult EP experts
- Communicating and documenting treatment options and management plans effectively to patients, families, referring physicians and health care professionals

3. Judicious mapping to domains of competence

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<tr>
<th></th>
<th>Patient Care</th>
<th>Medical Knowledge</th>
<th>Practice-based Learning and Improvement</th>
<th>Interpersonal &amp; Communication Skills</th>
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4. Competencies within each domain critical to entrustment decisions

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<th></th>
<th>PC 6: Clinical judgment</th>
<th>PC 7: Management</th>
<th>MK 1: Knowledge</th>
<th>ICS 4: Team member or leader</th>
<th>ICS 6: Medical Records</th>
<th>PPD 1: Help seeking</th>
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</table>
5. Curricular components that support the functions of the EPA (knowledge, skills and attitudes needed to execute this EPA safely):

Rationale: Pediatric electrophysiology (EP), the scope of which is the care of conduction and rhythm abnormalities in pediatric patients and adults with congenital heart abnormalities is an essential part of being a pediatric cardiologist. It is also important to have an understanding of electrophysiology as it relates to screening for the above abnormalities.

Scope of practice: This includes the knowledge and skill needed in performing, interpreting and reporting basic noninvasive EP tests (e.g., ECG, Holter recording, event recording, exercise ECG) as well as basic pacing and pacemaker troubleshooting. It also includes the knowledge and skill to manage basic conduction and rhythm abnormalities (e.g., supraventricular tachycardia in a structurally normal heart, peroperative arrhythmia after congenital heart surgery, and fetal arrhythmias). Finally, it also includes the knowledge of indications and limitations of other more invasive EP testing and procedures and when to refer to an EP specialist.

Settings: general inpatient, intensive care unit, and outpatient. Consultation may be routine or acute/emergent.

Patient population: fetus, infant, child, adolescent, and adult

Curricular Components that support the functions of the EPA:

Obtaining essential information and testing
- Evaluates young patients with syncope, palpitations, supraventricular arrhythmias, ventricular arrhythmias, atrioventricular conduction disturbances, and all forms of early postoperative arrhythmias.
- Demonstrates skill in risk assessment for sudden death in young patients having cardiac disorders and in those with nonspecific or nonspecific symptoms or laboratory findings.

Knowing the underlying mechanisms of cardiac electrical conduction/rhythm generation and indications for electrocardiography (ECG), Exercise testing, Holter monitoring, and event recording as well as knowing the basics of Invasive EP.
- Knows the developmental changes in cardiac rates and rhythm with age.
- Knows the basic mechanism of arrhythmias.
- Knows the clinical presentation and mechanisms of supraventricular tachycardia.
- Knows the clinical presentation and mechanisms of ventricular tachycardia.
- Knows the clinical presentations and mechanisms of channelopathies and hereditary cardiomyopathies.
- Knows the clinical presentations of and mechanisms of Bradycardia and atrioventricular block.
- Knows the clinical presentations and diagnoses of fetal arrhythmias.
- Knows the presentations and mechanisms of palpitations, syncope, and sudden cardiac death in the young.

- Knows the mechanisms and types of arrhythmias in CHD.
- Knows about pacing modes, basic pacemaker interrogation (including determining pacing and sensing thresholds), pacemaker or ICD types, and basic trouble-shooting for pacemaker and implantable defibrillator therapy.
- Knows the indications for ECGs, ambulatory rhythm monitoring and event monitoring.
- Knows the indications, limitations, and types of exercise testing.
- Demonstrates a working knowledge of the genetics of channelopathies and cardiomyopathies, and the indications to order genetic testing.
- Demonstrates a general understanding of the indications and risks for nonpharmacologic electrophysiology (i.e. invasive EP) including knowledge of the physics of pacing, cardioversion, defibrillation, and therapeutic ablation of arrhythmia substrates.
- Knows the basic principles of mapping and catheter ablation.
- Knows the indications for arrhythmia surgery.

Performing an (ECG), Holter monitoring, event recording and exercise testing
- Knows how to place ECG leads.
- Recognizes lead placement errors.
- Knows the difference between a 12 lead and 16 lead EKG.
- Knows how to place a Holter recording.
- Knows how to place an event recorder.
- Knows the technical aspects of supervising an exercise test.

Interpreting ECGs, exercise testing, Holter monitoring and event recording, along with clinical integration of basic invasive EP data and aligning with comprehensive differential diagnoses
- Interprets a 12 lead ECG.
- Recognizes ECG changes associated with metabolic and other organ system derangements.
- Interprets Holter recordings.
- Interprets Event recordings.
- Interprets exercise testing.
- Understands the implications of basic intraarterial electrograms including interval measurements and integrates the interpretation into clinical management.
- Interprets postoperative arrhythmias.
- Integrates results of genetic testing for channelopathies in a general fashion.

Treating electrical abnormalities and knowing when to consult EP experts
- Treats young patients with syncope, palpitations, supraventricular arrhythmias, ventricular arrhythmias, atrioventricular conduction disturbances, and all forms of early postoperative arrhythmias and knows when to refer to EP experts.
- Appropriately provides risk stratification for sports participation.
- Integrates basic science knowledge of pharmacology, cellular and anatomic electrophysiology, molecular and clinical genetics, and rudimentary physics to patient care.
- Demonstrates knowledge of invasive methods for discriminating and treating arrhythmias.
- Manages acute pacing strategies including the use of temporary transvenous pacing catheters, esophageal electrode catheters, and percutaneous surgical wires.
- Provides management and follow-up of temporary pacing systems and understands the indications, techniques, and associated risks of elective and emergent direct current cardioversion.
- Identifies when to consult a specialist with advanced training in complex rhythm and conduction abnormalities described by the Pediatric and Congenital Electrophysiology Society (PAGES) and the heart rhythm society HRS (1). Advanced skills are listed below (2).

**Communicating the treatment options effectively to patients, families, referring physicians and health care professionals**
- Explains test results and management options to patients/families, primary care providers and other team members based on an individual’s health literacy.
- Engages patient, family and team members in shared decision making.

**Problems that generally require consultation where the role of the generalist is to recognize, provide preliminary evaluation and refer. This list depends greatly on context in which one practices. Those generalists practicing in areas where access to subspecialists is difficult will likely provide more of the care and may do so with telephone advice from a trusted subspecialist as needed.**
- Patients with pacemakers or intra-cardiac defibrillators ICDs who require pacemaker or ICD programming.
- Unstable patients with post-operative arrhythmias.
- Patients with supraventricular tachycardia or ventricular tachycardia who require multiple drugs for antiarrhythmic therapy.
- Patients who require invasive diagnostic or therapeutic electrophysiology studies.

**References:**
2. Advanced skills requiring advanced training: a. Advanced pacing modes, complex pacemaker interrogation, pacemaker or ICD programming, and basic troubleshooting for pacemaker and implantable defibrillator therapy. b. Invasive electrophysiology studies. c. Perform and teach arrhythmia mapping and catheter ablation. d. Knowing the intricacies of arrhythmia surgery. e. Knowing how to modify and utilize multiple drugs for antiarrhythmic drug therapy. f. Management of postoperative arrhythmias in the unstable patient.

**Curricular Components for Cardiology EPA**

<table>
<thead>
<tr>
<th>1. <strong>EPA Title</strong></th>
<th>Caring for patients who require catheter based interventions</th>
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<tr>
<td>2. <strong>Description of the Activity</strong></td>
<td>Upon completion of a general pediatric cardiology fellowship, the individual must: 1) understand the indications and appropriate timing for referral for diagnostic or interventional cardiac catheterization, 2) balance the potential complications of the procedure with the potential benefits, 3) compare the risk benefit profile to other options of therapy, 4) critically analyze the results of the catheterization procedure and 5) effectively communicate all of this information to the patient and other members of the care team. The specific functions which define this EPA include:</td>
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<td>• Demonstrating the skills and knowledge required to perform a thorough pre-catheterization assessment including detailed review of the medical history, current condition, physical examination, and relevant diagnostic studies.</td>
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<td>• Knowing the risks and benefits specific to the full spectrum of cardiac catheterization procedures and of potential non-cardiac catheterization options for optimal patient management.</td>
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<td>• Interpreting the hemodynamic and angiographic data.</td>
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<td>• Communicating the intent and risks of the procedure as well as the results of the procedure to patients, families, and professional colleagues.</td>
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<td>X Patient Care</td>
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<td>X Medical Knowledge</td>
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<td>4. <strong>Competencies within each domain critical to entrustment decisions</strong></td>
<td>PC 7: Management</td>
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<td>PC 9: Counseling</td>
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<td>MK 1: Knowledge</td>
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<td>PBLU 5: Formative feedback</td>
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<td>SBP3: Cost awareness</td>
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</table>
5. Curricular components that support the functions of the EPA (knowledge, skills and attitudes needed to execute this EPA safely):

**Rationale:** Pediatric cardiologists must be able to manage the care of patients requiring cardiac catheterization as well as interpret data generated from the procedure.

**Scope of practice:** The care of patients who require cardiac catheterization is an essential activity of a pediatric cardiologist. All pediatric cardiologists must understand the indications, risks, benefits and limitations of cardiac catheterization and have the ability to correctly analyze and utilize the catheterization data. The patient population includes the fetus, infant, child, adolescent and adult with congenital or acquired heart disease. This document is intended to address the scope of knowledge and skills of pediatric cardiologists referring their patients for cardiac catheterization. As such, it focuses on activities required to make an appropriate referral and provide care after the procedure with the understanding that the pediatric cardiologist will recognize his/her own limitations and seek additional assistance from a pediatric interventional cardiologist as needed.

**Setting:** Diagnosis and management in the following settings: inpatient, outpatient, consultation, routine and acute/emergent or intensive care environment.

**Patient population:** infant, child, adolescent, and adult

**Curricular Components that support the functions of the EPA:**

Demonstrating the skills and knowledge required to perform a thorough pre-catheterization assessment including detailed review of the medical history, current condition, physical examination, and relevant diagnostic studies:
- Determines the general state of the patient.
- Orders the relevant diagnostic studies based on cost-benefit analysis for the individual patient and shared decision-making with the patient and family.
- Interprets the relevant diagnostic studies in the context of the history and physical examination.
- Knows the indications and contraindications for catheterization and specific interventions.
- Recommends appropriate and timely catheterization referral.
- Seeks and incorporates feedback from interventional consultants regarding pre-referral diagnostic work-up and management.

Knowing the risks and benefits specific to the full spectrum of cardiac catheterization procedures and of potential non-cardiac catheterization options for optimal patient management:
- Describes the risks and benefits of diagnostic and common interventional cardiac catheterization procedures*.
- Describes the principles of radiation safety.
- Describes basic procedural methodologies of diagnostic catheterization and common interventions.

- Explains the alternative diagnostic options.
- Explains the alternative management options, including medical and surgical.

Interpreting the hemodynamic and angiographic data:
- Distinguishes normal pressure data, including waveforms, from abnormal data.
- Determines pressure gradients.
- Applies thermodilution and the Fick principle for cardiac output measurement and resistance calculations.
- Interprets the results of angiography.
- Synthesizes the catheterization data into a unified diagnosis where possible.
- Determines the procedural result to be successful or unsuccessful where possible.

Communicating the intent and risks of the procedure as well as the results of the procedure to patients, families, and professional colleagues:
- Communicates with the patient/family and ensures their understanding of the indications, risks, benefits, alternatives and potential complications.
- Elicits and takes into account patient preferences in making recommendations.
- Communicates the results of the procedure to the patient/family and ensures their understanding.
- Communicates the catheterization data, both orally and in written form, to interdisciplin ary colleagues.

* Common interventional cardiac catheterization procedures include the following:
- Valvuloplasty
- Arterial/venoplasty
- Device closure
- Stent placement
- Balloon atrial septostomy
- Endomyocardial biopsy
| 1. EPA Title | Diagnosis, initial management, and referral of children with advanced or end stage heart failure and/or pulmonary hypertension to experts for medical therapy, ECMO, ventricular assist device and/or cardiac transplantation. |
| 2. Description of the Activity | Upon completion of a general pediatric cardiology fellowship, the individual must be familiar with the latest and most effective pharmacologic and surgical treatments for children with advanced heart failure and/or pulmonary hypertension. The specific functions which define this EPA include: |
| | • Performing a comprehensive evaluation for the etiologies of heart failure and pulmonary hypertension including clinical and laboratory assessment, noninvasive, invasive and genetic testing |
| | • Demonstrating expertise in the interpretation of hemodynamic testing and the implications for therapeutic intervention |
| | • Initiating targeted treatment for heart failure and for pulmonary hypertension |
| | • Knowing when to refer patients with disease refractory to medical therapy to heart failure or pulmonary hypertension experts for advanced therapies, including ECMO, assist devices, and heart and/or lung transplantation |
| | • Counselling patient and families regarding prognosis and treatment options |
| | • Coordinating multidisciplinary care with other subspecialties such as neonatal or critical care, cardiothoracic surgery, genetics, respiratory care, nursing, social work and child life |
| | • Participating in the cardiac care of a patient before, during and after transplantation |
| 3. Judicious mapping to domains of competence | Patient Care |
| | Medical Knowledge |
| | Practice-based Learning and Improvement |
| | Interpersonal & Communication Skills |
| | Professionalism |
| | Systems-based Practice |
| | Personal and Professional Development |
| 4. Competencies within each domain critical to entrustment decisions | PC4: Interview patients |
| | MK1: Knowledge |
| | PSL1: EBM |
| | ICS: Insight into emotion |
| | SFB: Coordinate care |
| | SSB: Interprofessional teams |
| 5. Curricular components that support the functions of the EPA (knowledge, skills and attitudes needed to execute this EPA safely): | Rationale: The diagnosis and initial management of infants and children with pulmonary hypertension or heart failure is essential for pediatric cardiology fellowship education. Trainees will be expected to diagnose, initially manage, and refer children with AHF or ESHF and/or PH to experts for medical therapy, ECMO, ventricular assist device and/or cardiac transplantation. |
| | Scope of practice: Care of all patients with known or suspected cardiac problems that would generally be seen by a general pediatric cardiologyist referred for expertise in AHF, ESHF and PH as the disease processes advances. |
| | Setting: Diagnosis and management in the following settings: general inpatient, intensive care units, and outpatient areas. Consultation may be both routine and acute/emergent. |
| Patient population: infant, child, adolescent, and young adult |
| Curricular Components that support the functions of the EPA: | Performing a comprehensive evaluation for the etiologies of heart failure and pulmonary hypertension including clinical and laboratory assessment, noninvasive, invasive and genetic testing |
| | • Performs the initial evaluation and management of the child with PH in the outpatient ambulatory setting. |
| | • Performs the initial evaluation and stabilization of the hemodynamically compromised patient with PH. |
| | • Knows the indications, risks, and benefits of medications used for the treatment of PH. |
| | • Demonstrates knowledge of the indications and appropriate timing of referral to a dedicated specialist in pediatric or adult PH for advanced care and the evaluation and treatment of the ambulatory child with AHF. |
| | • Provides the initial evaluation and stabilization of the hemodynamically compromised patient with heart failure. |
| | • Administers medications approved or commonly used for the treatment of heart failure. |
| | • Refers to dedicated subspecialist for consideration of advanced management options including mechanical circulatory support and transplantation evaluation. |
| | • Co-manages cardiology care with a specialized center of a recipient who has undergone transplantation. |
| | • Demonstrates knowledge of the patterns of heritable cardiomyopathies and genetic |
Demonstrating expertise in the interpretation of hemodynamic testing and the implications for therapeutic intervention

PULMONARY HYPERTENSION
- Discriminates between pulmonary hypertension and pulmonary arterial hypertension physiology.
- Discriminates between normal and abnormal pulmonary vascular physiology, including the “neonatal transition” in pulmonary vascular resistance.
- Applies knowledge of the distinction between pulmonary hypertension and elevated pulmonary vascular resistance (i.e., hypertensive pulmonary vascular disease) in the care of patients.
- Demonstrates knowledge of pulmonary vascular pathophysiology, including the physiological and clinical meaning of “reactivity” to vasodilators.
- Demonstrates knowledge of the indications/contraindications for repair of congenital cardiac lesions in the presence of pulmonary vascular disease.
- Performs key components of an initial evaluation of PH utilizing appropriate non-invasive and invasive imaging to discriminate and evaluate multiple etiologies including: persistent pulmonary hypertension of the newborn, congenital heart disease (including Eisenmenger physiology), PH associated with left heart disease, PH associated with chronic lung disease, and iatrogenic PH.
- Demonstrates knowledge about the indications, risks, benefits, and outcomes of lung or heart-lung transplantation in children with PH.
- Demonstrates the skills to plan an appropriate referral for consultation with a dedicated specialist in pediatric or adult PH.
- Demonstrates the skills to counsel families regarding the acute and chronic care of the child with pulmonary hypertension.

HEART FAILURE
- Demonstrates knowledge of and recognizes the etiology, signs and symptoms of heart failure in children.
- Evaluates diagnosis utilizing appropriate non-invasive, invasive imaging, genetic, metabolic, electrophysiological testing and provides initial treatment for pediatric patients with heart failure of various etiologies.
- Demonstrates knowledge and use of the indications, mechanism of actions, risks, and benefits associated with the FDA-approved medications for use in adults with heart failure and medications commonly used in pediatric patients with heart failure.
- Plans appropriate consultation with a dedicated specialist in pediatric advanced heart failure therapies.

Initiating targeted treatment for heart failure and for pulmonary hypertension
- Demonstrates knowledge of the Consensus Guidelines for the Treatment of Heart Failure (American Heart Association (AHA) and International Society of Heart and Lung Transplantation (ISHLT)).

Knowing when to refer these patients with disease refractory to medical therapy to heart failure or pulmonary hypertension experts for advanced therapies for disease refractory to medical therapy, including ECMO, assist devices, and heart and/or lung transplantation
- Demonstrates knowledge of indications, risks and benefits of advanced heart failure therapies.
- Knows limitations and searches the literature for the highest grade of evidence available.
- Applies the evidence to and knows when to refer children with advanced or end stage heart failure and/or pulmonary hypertension to experts for medical therapy, ECMO, ventricular assist device and/or cardiac transplantation.

Counselling patient and families regarding prognosis and treatment options
- establishes the level of understanding of the patient and family about the disease process.
- Engages the patient, family and team members in shared decision making.
- Engages with the patient/family in deciding on the right time to refer to a subspecialist for a second opinion and further counseling.

Coordinating multidisciplinary care with other subspecialties such as neonatal or critical care, cardiothoracic surgery, genetics, respiratory care, nursing, social work and child life
- Communicates with colleagues in multiple disciplines to coordinate care.
- Works in interprofessional teams to improve patient care and quality of life.
- Provides access to resources or other team members who can access resources for the patient/family.

Participating in the cardiac care of a patient before, during and after transplantation
- Co-manages the patient along with the consultant.
- Opens a dialogue with the consultant that allows for a bidirectional exchange of information after each patient encounter.

Managing medications and social challenges of medication compliance in outpatient follow up of patients
- Discusses medication check list with patients.
- Assesses medication noncompliance (social challenges).
- Gauges health literacy of patients/families and counsels accordingly to help them take control over aspects of their disease such as medication adherence.
- Engages members of the Interdisciplinary team to help with medication adherence.

Problems that generally require consultation where the role of the general cardiologist is to...
Curricular Components for Cardiology EPA

1. **EPA Title**
   Diagnosis and management of congenital or acquired cardiac problems

   Recognize, provide preliminary evaluation and refer. This list depends greatly on context in which one practices. Those generalists practicing in areas where access to subspecialists is difficult will likely provide more of the care and may do so with telephone advice from a trusted colleague.

   - Children with inotropic dependency (HF)
   - Children with heart failure who require mechanical ventilation (HF)
   - Children with inotropic dependency +/- organ dysfunction (renal, liver) who might require mechanical support (HF)
   - Patients requiring more than one inotrope (HF)
   - Newborns and infants with diaphragmatic hernia (PHN)
   - Newborns and infants with persistent pulmonary hypertension (PHN)
   - Children with Eisenmenger (PHN)
   - Infants and children who may need pulmonary hypertension medications (pulmonary vasodilator medication, not including nitric oxide) (PHN)

   Reference:

2. **Description of the Activity**
   Pediatric cardiologists, completing training, are expected to be able to diagnose and manage a broad range of congenital and acquired cardiac problems. These may include but are not limited to cyanotic congenital heart disease (CHD) in the newborn, left to right shunt lesions; such as, atrial septal defect (ASD), ventricular septal defect (VSD), patent ductus arteriosus (PDA), outflow obstruction lesions (e.g., aortic stenosis, pulmonary stenosis, coarctation), cardiomyopathies, Kawasaki Disease, dyslipidemia and cardiac manifestation of genetic syndromes (e.g., Down, Marfan, Turner, Noonan, Williams, DiGeorge).

   The specific functions which define this EPA include:
   - Knowing and understanding the natural and unnatural history, as well as unique cardiovascular anatomy and physiology seen in CHD
   - Obtaining a complete history and physical examination
   - Obtaining a thorough family history with a focus on genetic abnormalities associated with an important risk of heart disease in childhood
   - Developing a prioritized differential diagnosis
   - Knowing the risks and benefits of non-invasive and invasive evaluation of infants, children and young adults with congenital or acquired cardiovascular disease and applying these when ordering diagnostic testing in a cost effective manner.
   - Developing a management plan that incorporates medical therapy, interventional catheter procedures, and surgical intervention as well as addressing the psychosocial aspects of acute chronic disease.
   - Communicating with and counseling the patient/family regarding immediate, mid- and long-term management
   - Evaluating and managing acquired cardiac conditions found in pediatric patients
   - Identifying and applying key evidence-based guidelines
   - Recognizing cardiac conditions and indications that might require additional sub-specialty expertise

3. **Judicious mapping to domains of competence**

   - <X> Patient Care
   - <X> Medical Knowledge
   - <X> Practice-based Learning and Improvement
   - <X> Interpersonal & Communication Skills
   - <X> Professionalism
   - <X> Systems-based Practice
   - <X> Personal and Professional Development
4. Competencies within each domain critical to entrustment decisions

| PC 1: Gather information
| PC 5: Physical examination
| PC 6: Clinical judgment
| PC 9: Counseling
| MK 1: Knowledge
| ICS 1: Communication with patients
| ICS 4: Team member or leader

5. Curricular components that support the functions of the EPA (knowledge, skills and attitudes needed to execute this EPA safely):

Rationale: The fundamental goal of clinical pediatric cardiology training is to acquire the diagnostic skills necessary to provide optimal inpatient, outpatient and consultative care to the fetus, infant, child and young adult with congenital or acquired cardiovascular disease.

Scope of practice: Diagnosis and management of congenital and acquired pediatric cardiovascular disease can occur in a variety of clinical settings, including the outpatient clinic, the inpatient wards, the newborn nursery, and the neonatal, pediatric, and cardiovascular intensive care units. The fundamental skills of history taking and physical examination form the basis for correctly initiating diagnostic assessment and determining management options appropriate for the individual patient. Knowledge of cardiac anatomy and physiology, the natural history of untreated and treated congenital and acquired cardiovascular disease, the risks and benefits of standard diagnostic tests, as well as current evidence-based guidelines for management of congenital or acquired cardiovascular disease, all establish the foundation for optimal patient care.

The curricular components listed in this document adhere to current guidelines, such as those listed in the reference section below. Furthermore, there is the expectation of continued self-directed/learning toward ongoing advances in diagnosis and treatment.

Setting: Diagnosis and management in the following settings: inpatient, outpatient, consultation, routine and acute/emergent or intensive care environment.

Patient population: fetus, infant, child, adolescent, and adult

Curricular Components that support the functions of the EPA:

Knowing and understanding the natural and unnatural history as well as the unique cardiovascular anatomy and physiology seen in CHD
- Demonstrates knowledge of the pathophysiology and natural history of left to right shunt lesions, cyanotic CHD, valve abnormalities and other congenital systemic and arterial vascular abnormalities.

- Demonstrates knowledge of diagnosis, care and management of critical CHD
- Knows the different congenital coronary artery abnormalities, including pathophysiology and modes of presentation of congenital coronary artery abnormalities.

Obtaining a complete history and physical examination
- Demonstrates skills for obtaining a complete, age-specific history.
- Knows normal age-related vital sign values, including pulse, respirations, expected values for four-extremity blood pressures and pre- and post-dural oxygen saturations.
- Performs a successful and complete cardiac physical examination, including auscultation in infants, toddlers, children and young adults.
  - Accurately describes the location and intensity of cardiac sounds, clicks, snaps, murmurs, rubs and gallops.
  - Differentiates stridor, wheeze, rales and rhonchi on auscultation of lungs.
- Recognizes abnormalities of cardiac performance by palpation of precordium, suprasternal notch, abdomen and peripheral pulses.
- Recognizes and differentiates infants, children and young adults with primary cardiac disease from those with cardiac disease as part of a complex systemic disease process.
- Recognizes signs of respiratory distress and signs of impending respiratory failure.
- Recognizes physical signs of low cardiac output and signs of impending cardiac arrest.
  - Differentiates central from peripheral cyanosis and cardiac from non-cardiac causes of cyanosis.
  - Differentiates acute from chronic hypoxemia.

Obtaining a thorough family history with a focus on genetic abnormalities associated with an important risk of heart disease in childhood
- Obtains a thorough family history focusing on congenital and acquired heart disease.
- Recognizes common genetic syndromes, and their associated cardiac abnormalities.
- Recognizes important non-cardiac abnormalities associated with certain genetic abnormalities or syndromes.
- Demonstrates knowledge of the various methods of genetic testing that are available, along with appropriate and cost-effective use of this testing where applicable.

Developing a prioritized, differential diagnosis
- Knows the signs/symptoms of CHD and acquired heart disease across the spectrum of ages from neonate to young adult.
- Synthesizes clinical findings into an appropriate, prioritized differential diagnosis.

Knowing the risks and benefits of non-invasive and invasive evaluation of infants, children and young adults with congenital or acquired cardiovascular disease, and applying these when ordering diagnostic testing in a cost effective manner
- Prioritizes and orders diagnostic testing to optimize knowledge acquisition, minimize patient risk and discomfort, and be cost-effective.
- Interprets an electrocardiogram (EKG) for acute and/or chronic changes of rate, rhythm, P or QRS axis, ventricular hypertrophy, atrial enlargement, PR interval, QRS duration, corrected QT intervals, ST and T wave changes.
• Knows the indications for obtaining, and has the skills to interpret, chest x-rays based upon the differential diagnosis.
• Knows the indications for, and has the skills to perform and interpret, transthoracic echocardiograms based upon the differential diagnosis.
• Knows the indications and risks, and has the skills to interpret, hemodynamic and angiographic data obtained from diagnostic and interventional cardiac catheterization.
• Knows the indications and risks and has the skills to interpret advanced imaging such as CT angiograms and cardiac magnetic resonance imaging (MRI).

Developing a management plan that incorporates medical therapy, interventional catheter procedures and surgical intervention as well as addressing the psychosocial aspects of acute and chronic disease.
• Demonstrates the skills to develop appropriate initial management plans based upon physiology, including recognizing ductal-dependent lesions and utilizing PGE1 appropriately.
• Knows and understands the medical and surgical interventions for the various types of acyanotic and cyanotic congenital heart disease, including the timing of the interventions, and expected/unexpected complications.
• Knows and understands the medical and surgical interventions for the various types of acquired heart disease, including the type and timing of interventions, and expected/unexpected complications.
• Coordinating both acute and chronic care with interprofessional management teams, to meet the medical, social, developmental, behavioral, mental health, educational and financial needs of the patient and family.

Communicating with and counseling the patient/family regarding immediate, mid- and long-term management
• Communicates the clinical findings, diagnosis and management plan to the patient/family, using understandable terms and concepts, and avoiding the use of excessive jargon.
• Explains and interprets the test results for the patient/family in a timely manner.

Evaluating and managing acquired cardiac conditions found in pediatric patients
• Evaluates and manages basic arrhythmias (tachy/bradyarrhythmias) based on the type of arrhythmia, mechanisms of action, and available therapies.
• Evaluates and manages cardiac masses, tumors, pericardial disease.
• Evaluates chest pain (cardiac and noncardiac) in children and adolescents and manages chest pain of cardiac origin.
• Evaluates and manages syncope.
• Evaluates for cardiac etiology and effects of systemic hypertension
• Evaluates and manages hypercholesterolemia and other dyslipidemias.
• Evaluates and manages Kawasaki Disease.
• Evaluates and manages rheumatic heart disease and its associated cardiac manifestations/complications.
• Evaluates and manages infective endocarditis.

Identifying and applying key evidence-based guidelines

• Conducts a search to find and adhere to current clinical practice guidelines, if available, for management of the various types of congenital and acquired heart disease.
• Explains the various grades of evidence, searches the literature for evidence focusing on the highest-grade evidence available.
• Finds and assesses medical literature for optimal management strategies in the absence of evidence and guidelines.

Recognizing cardiac conditions and indications that might require additional sub-specialty expertise
• Recognizes and referrals/co-manages patients with cardiomyopathy and end stage heart failure.
• Recognizes and referrals/co-manages primary pulmonary hypertension.
• Recognizes and referrals/co-manages patients with complex arrhythmias
• Refers as needed for pacemaker assessment and management.
• Recognizes limitations and demonstrates help seeking behavior by referring patients to invasive or non-invasive imaging experts as needed.

Reference:
1. EPA Title

Diagnosis and management of patients with acute congenital or acquired cardiac problems requiring intensive care.

2. Description of the Activity

Upon completion of a general pediatric cardiology fellowship, the individual must have the knowledge base and ability to critically analyze information to formulate a care plan specific to the patient's cardiac needs for disease states common to an intensive care unit.

The specific functions define this EPA include:

- Evaluating and treating neonates, infants and older pediatric patients with critical structural cardiac diseases
- Evaluating and treating neonates, infants and older pediatric patients with other forms of critical cardiac disease
- Providing consultation to those caring for postoperative cardiac patients
- Providing direct care or consultation to those responsible for primary care for patients with illnesses of non-cardiac origin
- Functioning as a member of a multidisciplinary team demonstrating professionalism and excellent communication skills
- Participating in quality improvement and patient safety initiatives

3. Judicious mapping to domains of competence

- Patient Care
- Medical Knowledge
- Practice-based Learning and Improvement
- Interpersonal & Communication Skills
- Professionalism
- Systems-based Practice
- Personal and Professional Development

4. Competencies within each domain critical to entrustment decisions

PC 3: Transfer of care
PC 6: Clinical judgment
MK 1: Knowledge
PBIL 4: Analyze practice
ICS 1: Communicate with patients
ICS 3: Communicate with health professionals
ICS 4: Member or leader
SBP 5: Interprofessional teams

5. Curricular components that support the functions of the EPA (knowledge, skills and attitudes needed to execute this EPA safely):

Knowledge, skills and attitudes needed to execute the EPA safely (refer to Task Force Curriculums).

Rationale: Pediatric cardiologists must be able to care for patients with cardiac problems of all levels of severity, ranging from the relatively well patient in the outpatient clinic to those requiring intensive care. To achieve the best clinical outcomes, every pediatric cardiologist should have basic patient assessment and stabilization skills, command a clear understanding of complex cardiovascular anatomy and physiology, know the effects of pharmacological agents and surgical interventions on cardiac physiology, and function as an effective communicator within a multidisciplinary team.

Scope of Practice: This activity includes caring for patients of all ages, including neonates (some preterm), infants, older pediatric patients, and in certain circumstances, adults with congenital heart disease. There can be institutional variation in the intensive care environment and in age of patients cared for in that particular environment (e.g., whether there is a dedicated CICU vs PICU or NICU). However, the skills described here, such as establishing a diagnosis, counseling families, having knowledge of medical, interventional, and surgical therapies, and patient stabilization, apply to both the general pediatric cardiologist called to consult on a cyanotic newborn at a community hospital and to the frontline pediatric cardiologist in a cardiovascular intensive care setting. As such, the scope of practice includes functioning as a consultant to other services, as well as receiving consultation from advanced pediatric cardiac subspecialists such as pediatric electrophysiologists, heart failure/transplant specialists, or non-invasive cardiac imagers. Institution-specific details would thus be dependent on the setup of each individual institution vis a vis each provider of care as well as patient care in each setting.

The scope of care includes involving and treating those patient groups who have critical structural cardiac disease and other forms of critical cardiac disease as detailed below:

- Providing consultation to those providing primary care for patients with illnesses of a noncardiac origin
- Providing consultation to those caring for postoperative cardiac patients
- Functioning as a member of a multidisciplinary team demonstrating professionalism and excellent communication skills; quality improvement, and patient safety.

Caring for patients with cardiac disease requiring intensive care necessitates application of specific knowledge and skills, including cardiopulmonary physiology, the relationship between cardiac structure, function, and hemodynamic state, multi-organ system management, pharmacology as it relates to cardiovascular physiology, diagnosis and management of arrhythmias, as well as airway management and cardiopulmonary support, including resuscitation and mechanical circulatory support. The specific knowledge/skills listed above are reflected particularly in the first three functions described below. Practicing in a cardiac ICU requires a general facility with all aspects of cardiac care, as well as knowledge of when to consult with advanced cardiac subspecialists.

Setting: Diagnosis and management in the following settings: inpatient, outpatient, consultation, routine and acute/emergent or intensive care environment.

Patient population: neonate, infant, child, adolescent, and adult

Curricular components that support the function of the EPA:

Evaluating and treating neonates, infants and older pediatric patients with critical structural cardiac diseases

- Establishes an accurate anatomic diagnosis and ascertains the relevant...
cardiopulmonary physiology compared to normal physiology across all pediatric ages, including interpretation of diagnostic studies, such as, echocardiograms and catheterizations with understanding of the limitations of these and other studies.

- Knows how to triage patients and which patients require ICU observation for potential risk of decompensation or to meet immediate medical needs.
- Provides appropriate medical therapy to stabilize the patient with confirmed or suspected critical cardiac disease (providing for adequate oxygen delivery and organ perfusion), including determining the need for the initiation of prostaglandin E1, intubation, inotropic support, and central line placement.
- Knows the indications for and limitations and risks of invasive testing and procedures, including issues related to sedation, anesthesia, and intra-hospital transport of the critically ill patient with cardiac disease.
- Knows what medical and surgical treatments are appropriate for the cardiac condition, and the short and long-term outcomes of these therapies.
- Recognizes patients who are deviating from the usual postoperative course after previously performed cardiac operations, specifically those patients who have a residual cardiac lesion, either due to an imperfect operation or incomplete preoperative diagnosis. Plans appropriate anatomic investigation and determines the need to recommend surgical or transcatheter intervention weighing the risks and benefits of the intervention.
- Manages the patient with many forms of congenital heart disease at many ages, with a focus on:
  - Neonates and young infants with ductal-dependent right heart obstructive lesions
  - Neonates and young infants with ductal-dependent left heart obstructive lesions
  - Neonates and young infants with severe Eisenmenger’s anomaly
  - Neonates and young infants with pulmonary atresia with ventricular septal defect and multiple aortopulmonary collateral vessels
  - Neonates with d-transposition of the great arteries
  - Neonates with total anomalous pulmonary venous connection with obstruction
  - Infants with anomalous origin of a coronary artery from the pulmonary artery
  - Single-ventricle patients with staged palliation
  - Mural lesions
  - Pulmonary and systemic ventricles stressed by abnormal preload or afterload

Evaluating and treating neonates, infants, and older pediatric patients with other forms of critical cardiac disease

- Establishes an accurate diagnosis and ascertains the relevant cardiopulmonary physiology compared to normal physiology across all pediatric ages.
- Knows how to triage patients and which patients require ICU observation for potential risk of decompensation or to meet immediate medical needs.
- Provides appropriate medical therapy to stabilize the patient (provides for adequate oxygen delivery and organ perfusion).
- Knows the indications for and limitations and risks of invasive testing and procedures, including issues related to sedation, anesthesia, and intrahospital transport of the critically ill patient with cardiac disease.
- Knows what medical and surgical treatments are appropriate for the cardiac condition, and the short and long-term outcomes of these therapies.
- Manages the patient with other forms of critical cardiac disease, including those with:
  - Primary myocardial dysfunction
  - Acute compromised cardiopulmonary status due to viral myocarditis or decompensated end-stage cardiomyopathy.
  - Acutely symptomatic arrhythmias
  - Acute compromised cardiopulmonary status that is due to infectious endocarditis/febrile and inflammatory (non-infectious) endocarditis.
  - Pericardial effusion and tamponade, including supervised pericardiocentesis as indicated.
  - Elevated pulmonary vascular resistance, with or without a structural abnormality of the heart.

Providing consultation to those caring for postoperative cardiac patients

- Provides interpretation of diagnostic studies such as echocardiograms and heart catheterizations, including a clear delineation of the limitations of such studies.
- Diagnoses and treats acutely symptomatic arrhythmias.
- Provides consultation regarding therapies to maximize oxygen delivery and cardiac output.
- Provides consultation regarding pharmacologic and other therapies for patients with single-ventricle physiology.
- Provides consultation regarding therapies for patients with high pulmonary vascular resistance and pulmonary hypertension.
- Knows the factors that predispose to common postoperative complications and the appropriate diagnostic techniques and therapies to address them.

Providing direct care or consultation to those responsible for primary care for cardiac patients with illnesses of non-cardiac origin

- Knows the risks posed to the cardiac patient undergoing non-cardiac surgery.
- Recognizes when a different treatment approach is needed compared to a patient with a normal heart.
- Communicates the cardiovascular physiological concerns for the patient to other care providers and collaborates in developing an appropriate care plan.

Functioning as a member of a multidisciplinary team demonstrating professionalism and excellent communication skills

- Provides unbiased information to the patient/family regarding known causes of congenital heart disease, the genetic and developmental implications, and treatment options.
- Conducts oneself in a respectful and collegial manner in the CICU, exhibiting the utmost professionalism in interactions with nurses, social workers, nutritionists, case managers, respiratory therapy, support staff, and other physicians.
- Communicates the entire clinical picture for the family and the care team in an ongoing
Participating in quality improvement and patient safety initiatives
- Demonstrates (via participation) the understanding of and rationale for quality improvement and patient safety initiatives in the intensive care unit setting; knows the impact (or potential impact) of these on day-to-day care and patient outcomes, including frequent assessment of the need for invasive monitoring/access, procedures to reduce iatrogenic infections, and techniques to reduce medication errors.
- Applies the principles behind a quality improvement process and recognizes and abides by the principles of safe care delivery in the hospital.
- Knows and applies the elements of an effective handover of care between services.
- Knows the common complications that occur in cardiac patients in the ICU and how they may be prevented and treated.

Additionally, there are problems that generally require consultation where the role of the general cardiologist is to recognize, provide preliminary evaluation, and obtain consultation. This list depends greatly on context in which one practices. Those cardiologists practicing in areas/centers where access to cardiac subspecialists is difficult will likely provide more of this care and may do so with remote advice from a trusted consultant as needed.
- Interpretation of intra-operative or bedside transesophageal echocardiographic data and the implications for management.
- Initiation of second-line or atypical pharmacologic therapies for difficult arrhythmias.
- Initiation and management of transesophageal pacing, complex temporary pacing (including poor thresholds and sensitivities), or complex permanent pacemakers and/or defibrillators.
- Management of immunosuppression in patients after heart transplantation.
- Initiation and management of advanced ventilation strategies.
- Initiation and management of renal replacement therapies.
- Management of patients not responding to first-line agents for sedation, analgesia, and neuromuscular blockade.
- Use of strategies to manage elevated intracranial pressure due to intracranial hemorrhage.

Reference:

Curricular Components for Cardiology EPA

1. EPA Title
   Application of the imaging skills required for all aspects of pediatric and congenital cardiology care

2. Description of the Activity
   Upon completion of a general pediatric cardiology fellowship, the individual must be able to perform a complete transthoracic echocardiogram (TTE) and be able to interpret and identify normal cardiac anatomy, exclude lesions associated with risk for sudden death, identify common pediatric and simple congenital heart disease and have knowledge of fetal and transesophageal echocardiography (TEE) and cardiac magnetic resonance imaging (MRI). They should be able to perform echocardiograms on patients with complex congenital heart defects and have sufficient knowledge to make a management plan and initiate treatment (1).

The specific functions which define this EPA include:
- Performing and interpreting complete TTE on children and young adults with normal hearts and with both normal and abnormal anatomy and function
- Communicating the results of these studies to patients, families, referring physicians and health care professionals
- Demonstrating the highest ethical principles and practices while performing, interpreting and communicating imaging studies
- Knowing the indications, strengths, and limitations of fetal and TEE
- Knowing the indications for, strengths, and limitations of cardiac MRI, CT scan, and nuclear imaging in diagnosis and management of acquired and congenital heart disease
- Searching the medical literature and applying evidence-based information to the non-invasive evaluation of a given patient’s cardiac anatomy and function

3. Judicious mapping to domains of competence
   - X Patient Care
   - X Medical Knowledge
   - X Practice-based Learning and Improvement
   - X Interpersonal & Communication Skills
   - X Professionalism
   - X Systems-based Practice
   - X Personal and Professional Development

4. Competencies within each domain critical to entrustment decisions
   - PCR: Procedures
   - MK1: Knowledge
   - PRL6: EBM
   - ICS3: Communicate with health professionals
   - IC66: Medical records
   - P2: Conduct
6. Curricular components that support the functions of the EPA (knowledge, skills and attitudes needed to execute this EPA safely):

**Rationale:** Cardiac imaging is fundamental to understanding anatomy and physiology when taking care of a patient with congenital or acquired heart disease. It is also an important screening tool to exclude the same. Cardiology fellows will be expected to be able to independently perform and interpret transthoracic echocardiography (TTE) upon completion of their fellowship as this is a necessary skill for the practice of the subspecialty.

**Scope of practice:** Knowledge and skill needed in performing, interpreting and reporting transthoracic echocardiography is an expectation of all general cardiologists. For other imaging modalities such as transesophageal echocardiography, fetal echocardiography, Cat Scan (CT) and Magnetic Resonance Imaging (MRI) only knowledge of indications, applications and limitations is expected. TTE services are provided as both inpatient and outpatient procedures. Competence in TEE, MRI, CT scan and fetal ECHO may require additional training after completion of core cardiology fellowship and for cardiologists who do not have additional training, consultation from colleagues with these advanced skills may be warranted. Practicing cardiologists should be aware of needs and advantages for multimodality imaging and refer patients accordingly.

**Setting:** Diagnosis and management in the following settings: Inpatient, outpatient, consultation, routine and acute/emergent or intensive care environment.

**Patient population:** fetus, infant, child, adolescent, and adult

**Curricular Components that support the functions of the EPA:**

**Performing and Interpreting TTE on children and young adults with both normal and abnormal anatomy and function**
- Demonstrates knowledge of the indication for the TTE prior to performing or interpreting one.
- Demonstrates knowledge of basic principles and physics of image acquisition and optimization inclusive of two dimensions, color and spectral Doppler.
- Demonstrates ability to choose appropriate transducer, imaging frequency (spatial versus harmonic) for two dimensional, color Doppler imaging and spectral Doppler acquisition.
- Demonstrates ability to maximize image acquisition quality by adjusting depth, gain, compression, transmit focal zone, lateral gain.
- Identifies imaging artifacts.
- Details assessment of anatomy using the segmental approach to cardiac anatomy.
- Details protocol inclusive of all views and their variations to allow for imaging a structurally normal heart, simple and complex cardiac lesions.
- Demonstrates knowledge regarding imaging details (views) that need to be acquired, interpreted and reported for the given indications.
- Uses appropriate nomenclature of congenital heart disease.
- Demonstrates knowledge and can perform of assessment of ventricular size and function, applies principles of function assessment to complex and repaired congenital heart disease with ventricles that do not conform to expected geometric configuration.
- Demonstrates knowledge of limitation and application of different 2D and 3D methods for assessment of ventricular mass calculation.
- Demonstrates ability to assess coronary anatomy.
- Demonstrates ability to assess ventricular hypertrophy and myocardial abnormalities.
- Demonstrates ability to assess hemodynamic data.
- Demonstrates ability to assess and differentiate pericardial disease from cardiac abnormalities e.g., tamponade from restrictive and constrictive process.
- Demonstrates knowledge of surgical techniques and assessment of repaired and palliated CHD.
- Demonstrates knowledge of standards and guidelines to assess atrioventricular and semilunar valve size and function.
- Demonstrates knowledge regarding indices used to assess diastolic function.
- Demonstrates knowledge of indications, imaging views, standards, risks and limitations of TEE.
- Applies knowledge of limitations of TTE and knows which additional or alternative imaging modality – MRI, CT or cardiac catheterization would be needed to get complete data that will allow for optimization of patient care.
  - Demonstrates knowledge of indications, imaging views, standards and limitations of fetal echocardiography.
  - Demonstrates knowledge of indications, imaging views, standards, risks and limitations of MRI and CT scan.
  - Demonstrates awareness of or participate in a process established for quality improvement and error identification and classification on TTE.
  - Knows when to order a MRI, CT scan or TEE in order to supplement TTE data and apply to patient assessment and management.
  - Demonstrates knowledge of application and use of non-invasive imaging modalities to guide interventions in cardiac catheterization and electrophysiologic (EP) studies.
  - Demonstrates knowledge of indications, contraindications and limitations to sedation utilized when performing procedures.

**Communicating the results of these studies to patients, families, referring physicians and health care professionals**
- Demonstrates knowledge of reporting elements for sorting a complete report of the performed TTE.
- Demonstrates ability (verbal/written) to convey the diagnosis and report it to the referring physician.
- Demonstrates skills needed to convey the diagnosis and incumbent management plans to the patients and/or their family or legal guardian.
- Communicates the results of the exam inclusive of hemodynamic and clinical implications in a simplified manner to patients and families.
- Communicates results to the referring and ordering physicians in a timely manner, with urgent and critical results that require change in medical management being communicated immediately to the ordering physician and care team.
Demonstrating the highest ethical principles and practices while performing, interpreting and communicating imaging studies
- Incorporates patients' and the care teams' knowledge and level of understanding in explaining the need for the procedure, the steps of the procedure and the interpretation of results.
- Communicates reliability and limitations of the study findings based on evidence that is free from personal bias.
- Encourages questions from patients, families and team members when discussing interpretation of results.

Knowing the indications, strengths and limitations of fetal echocardiography and TEE
- Fetal Echocardiography
  See the fetal echocardiography statement published in AHA (2).
  - Demonstrates knowledge about indications and gestational age at which a fetal echocardiogram can be performed.
  - Demonstrates knowledge of normal physiology of fetal and transitional circulation.
  - Demonstrates knowledge of alterations in fetal circulation associated with CHD and assesses impact of the findings on outcome.
  - Demonstrates knowledge of fetal arrhythmia evaluation, management, outcomes, and utility of fetal echocardiographic monitoring.
  - Demonstrates knowledge of extracardiac anomalies in the fetus that impact prenatal and perinatal outcome.
  - Demonstrates knowledge of existing innovations and standards in perinatal management.
- TEE
  - Demonstrates knowledge of application of TEE in assessment of vegetation, intracardiac abscess in endocarditis, and intracardiac thrombi.
  - Demonstrates knowledge in the use of TEE in guiding interventional procedures, pre and postoperative and intraoperative assessment.
  - Demonstrates knowledge of strengths and limitations of TEE in assessment of acquired and CHD.

Knowing the indications for strengths and limitations of cardiac MRI, CT scan, and nuclear imaging in diagnosis and management of acquired and congenital heart disease
- Demonstrates knowledge regarding radiation exposure and the safety precautions required with the use of these modalities.
- Demonstrates knowledge of utility of these tests in patient assessment.

Searching the medical literature and applying evidence-based information to the non-invasive evaluation of a given patient's cardiac anatomy and function
- Searches the literature for the most up to date information for purposes of educating patients and families, shared decision making with the health care team, and helping to deal with the anxiety that accompanies ambiguity/uncertainty.
- Searches the literature for evidence focusing on the highest grade evidence available

- Applies the evidence to the assessment and diagnosis of the congenital/acquired cardiac pathology and cardiomyopathy given the particular context for that patient.

References:
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References