



<b>National Imaging Associates, Inc.</b>	
<b>Clinical guideline</b> <b>TRANSTHORACIC (TTE) ECHO</b>	<b>Original Date: October 2009</b>
<b>CPT codes: 93303, 93304, 93306, 93307, 93308, +93320, +93321, +93325, +93356</b>	<b>Last Revised Date: August 2019</b>
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**ADULT PATIENTS – INDICATIONS FOR TRANSTHORACIC ECHOCARDIOGRAPHY (TTE)**

(Indications for pediatric patients follow this section)  
(Douglas 2011)

**Evaluation of Cardiac Structure and Function**

- Symptoms with a suspected cardiac etiology including, but not limited to, chest pain, shortness of breath (not clearly pulmonary in origin), or recent embolic event
- Palpitations with symptoms or signs of cardiovascular disease (i.e. abnormal physical exam or ECG)
- Hypotension of suspected cardiac etiology

**Murmur or Click**

- Initial evaluation when there is a reasonable suspicion for valvular or structural heart disease such as high grade, holosystolic, continuous or diastolic murmur

**Arrhythmias**

- Frequent ventricular premature contractions (PVCs) (greater than 30 per hour)
- Sustained or nonsustained ventricular tachycardia (VT) or ventricular fibrillation (VF), or ventricular bigeminy
- Atrial fibrillation without a prior transthoracic echocardiogram (TTE) to evaluate
- Unevaluated left bundle branch block

**Syncope** (Doherty 2017, Shen 2017)

- When initial evaluation including history, physical examination or electrocardiogram (ECG) suggests a cardiac etiology
- Exercise induced syncope

**Perioperative Evaluation** (Cowie 2010, Fleischer 2014, Lentine 2012)

- Preoperative left ventricular function assessment in patients who are candidates for solid organ transplantation (can be done yearly prior to transplant)

**Pulmonary Hypertension**

- Evaluation of suspected pulmonary hypertension including evaluation of right ventricular function and estimated pulmonary artery pressure
- Re-evaluation of known pulmonary hypertension if there is a change in clinical status or cardiac exam, or to guide therapy (can be performed every 6 - 12 months, or more frequently to guide therapy (Nazzareno 2016)
- Evaluation of patients with pulmonary embolism to risk stratify and initiate appropriate therapy (Saric 2016)
- Screening test for pulmonary hypertension in patients with scleroderma

### **Evaluation of Valvular Function**

(Doherty 2017, Doherty 2018, Nishimura 2014)

#### **Native Valvular Stenosis**

- Routine surveillance ( $\geq 3$  yrs) of bicuspid aortic valve, aortic sclerosis, or mild valvular stenosis, without a change in clinical status or cardiac exam
- Re-evaluation ( $\geq 1$  yr) of moderate stenosis without a change in clinical status or cardiac exam
- Re-evaluation of an asymptomatic patient with severe aortic stenosis (AS) every 6 - 12 months without a change in clinical status or cardiac exam
- Re-evaluation after medical therapy in patients with low-flow/low gradient severe AS

#### **Native Valvular Regurgitation with TTE** (Doherty 2017, Lancellotti 2013)

- Re-evaluation ( $\geq 3$  yrs) of mild valvular regurgitation without change in clinical status or cardiac exam
- Re-evaluation ( $\geq 1$  yr) of moderate valvular regurgitation without change in clinical status or cardiac exam
- Re-evaluation of asymptomatic patient every 6 - 12 months with severe aortic regurgitation
- Re-evaluation of asymptomatic patient every 6 - 12 months with severe mitral regurgitation

#### **Prosthetic Valves with TTE**

- Initial evaluation of prosthetic valve or native valve repair, for establishment of baseline, typically 6 weeks to 3 months postoperative
- Re-evaluation ( $\geq 3$  yrs after valve implantation) of prosthetic valve or native valve repair if no known or suspected valve dysfunction
- Evaluation of prosthetic valve or native valve repair with suspected dysfunction
- Re-evaluation of known prosthetic valve dysfunction when it would change management
- Annual evaluation of prosthetic heart valves older than 10 years
- Evaluation prior to pregnancy in patients with a prosthetic valve and no echocardiography within the past year

#### **Transcatheter Heart Interventions**

Transcatheter Aortic Valve Replacement (TAVR) (Doherty 2017, Otto 2017)

- Pre TAVR evaluation
- Post TAVR at 30 days (6 weeks to 3 months also acceptable) and annually

- Assessment post TAVR when there is suspicion of valvular dysfunction
- Assessment of stroke post TAVR with suspicion of valve dysfunction or thrombus

#### Percutaneous Mitral Valve Repair (Doherty 2017)

- Determination of patient eligibility
- Reassessment for degree of MR and left ventricular function (1, 6, and 12 months, and then annually to 5 yrs)

#### Closure of PFO or ASD (Doherty 2019)

- Pre-procedure evaluation
- Routine follow-up at 6 months for device position and integrity
- Evaluation for clinical concern for infection, malposition, embolization, or persistent shunt

#### Left Atrial Appendage (LAA) Occlusion (Doherty 2019)

- Pre-procedure evaluation

#### Pericardial Disease and Cardiac Source of Emboli (Doherty 2017, Klein 2013, Saric 2016)

- Suspected pericardial effusion or re-evaluation when findings would alter therapy
- Suspected pericardial constriction or re-evaluation of status when findings would alter therapy
- Re-evaluation of cardiac mass or tumor when findings would alter therapy
- Suspected cardiovascular source of embolus

#### Infective Endocarditis (Native or Prosthetic Valves) (Doherty 2017, Habib 2010, Nishimura 2014)

- Initial evaluation of suspected infective endocarditis with positive blood cultures or a new murmur
- Re-evaluation of infective endocarditis with a change in clinical status or cardiac exam, or when findings would change management
- Re-evaluation of patient with infective endocarditis at high risk of progression or complication (extensive infective tissue/large vegetation, or staphylococcal, enterococcal, or fungal infections)
- At completion of antimicrobial therapy and serial examinations at 1,3,6, and 12 months during the subsequent year (Habib 2010)

#### Thoracic Aortic Disease (Bhave 2018, Erbel 2014, Hiratzka 2010, Hiratzka 2016, Svensson 2013, Terdjman 1984)

In the absence of recent computed tomography (CT) or cardiovascular magnetic resonance (CMR), which are preferred for imaging beyond the proximal ascending aorta

- Screening of first degree relatives of individuals with a thoracic aortic aneurysm (defined as  $\geq$  50% above normal) or dissection, or if an associated high-risk mutation is present
- If one or more first degree relatives of a patient with a known thoracic aortic aneurysm or dissection, have thoracic aortic dilatation, aneurysm or dissection, then imaging of 2<sup>nd</sup> degree relatives is reasonable

- Six-month follow up after initial finding of a dilated thoracic aorta, for assessment of rate of change
- Annual follow up of enlarged thoracic aorta that is above top normal for age, gender, and body surface area
- Biannual (twice/year) follow up of enlarged aortic root  $\geq 4.5$  cm or showing growth rate  $\geq 0.5$  cm/year
- Evaluation of the ascending aorta in known or suspected connective tissue disease or genetic conditions that predispose to aortic aneurysm or dissection (e.g., Marfan syndrome, Ehlers Danlos or Loeys-Dietz syndromes) at time of diagnosis and 6 months thereafter for growth rate assessment, followed by annual imaging, or biannual (twice yearly) if diameter  $\geq 4.5$  or expanding  $\geq 0.5$  cm/yr
- Patients with Turner's syndrome should undergo imaging to assess for bicuspid aortic valve, coarctation of the aorta or dilation of the ascending or thoracic aorta. If the initial imaging is normal and there are no additional risk factors for dissection, imaging can be done every 5 - 10 years. If an abnormality exists, annual imaging is recommended
- Screening of first-degree relatives of patients with a bicuspid aortic valve
- Re-evaluation of known ascending aortic dilation or history of aortic dissection with a change in clinical status or cardiac exam or when findings may alter management
- Re-evaluation ( $< 1$  y, generally twice a year) of the size and morphology of the aortic sinuses and ascending aorta in patients with a bicuspid AV with 1 of the following:
  - Aortic diameter  $\geq 4.5$  cm
  - Rapid rate of change in aortic diameter when an annual growth rate of  $\geq 0.5$  cm is suspected.
  - Family history (first-degree relative) of aortic dissection
- Follow up post medical treatment of aortic disease:
  - Acute dissection: 1 month, 6 months, then annually
  - Chronic dissection: annually
- Follow up post either root repair or AVR plus ascending aortic root/arch repair: baseline post-op, then annually (Svensson 2013)
- Evaluation of sinus of Valsalva aneurysms and associated shunting secondary to rupture (Terdjman 1984). Echo imaging every 4-12 weeks is recommended during pregnancy and 6 months post-partum in patients with ascending aortic dilation (Regitz-Zagrosek 2018)

## **Hypertension, Heart Failure, or Cardiomyopathy**

### **Hypertension (Doherty 2018)**

- Initial evaluation of suspected hypertensive heart disease

### **Heart Failure & LV Function (Doherty 2018, Nagueh 2016, Patel 2013, Yancy 2013)**

- Initial evaluation of suspected heart failure (HF) (systolic or diastolic) based on symptoms, signs, or abnormal test results
- Re-evaluation of known HF (systolic or diastolic) with a change in clinical status or cardiac exam without a clear precipitating change in medication or diet

- Re-evaluation of known HF (systolic or diastolic) when essential to guide therapy
- Evaluation of LV function prior to cardiotoxic chemotherapy, and subsequently for monitoring
- Re-evaluation for CRT device optimization in a patient with worsening HF

### **Cardiomyopathy (Doherty 2018, Gersh 2011, Patel 2013, Regitz-Zagrosek 2018, Yancy 2013)**

- Initial evaluation of suspected inherited or acquired cardiomyopathy
- Re-evaluation of known cardiomyopathy with a change in clinical status or cardiac exam or to guide therapy
- Screening evaluation in first-degree relatives of a patient with an inherited cardiomyopathy
- Suspected cardiac sarcoidosis (see Overview)
- Hypertrophic Cardiomyopathy (HCM) (Gersh 2011)
  - Initial evaluation of suspected HCM
  - Re-evaluation of patients with HCM with a change in clinical status or new cardiovascular event
  - Evaluation of the result of surgical myomectomy or alcohol septal ablation
  - Re-evaluation every 1 - 2 years for symptomatically stable patients to assess degree of myocardial hypertrophy, dynamic obstruction, and myocardial function
  - Re-evaluation of clinically unaffected patients with a first-degree relative with HCM every 5 years
- Assessment of peripartum cardiomyopathy at onset and 3 months, then at 6 month intervals for minimum two years, or longer if required for surveillance during weaning medication, with additional follow up annually to 5 yrs. Re-evaluation for intended or actual recurrent pregnancy (Hilfiker-Kleiner 2015).

### **Device Candidacy (Pacemaker, ICD, or CRT)**

- Initial evaluation or re-evaluation after revascularization ( $\geq 90$  days) and/or myocardial infarction ( $\geq 40$  days) and/or 3 months of guideline-directed medical therapy to determine candidacy for device therapy and/or to determine optimal choice of device (Al-Khatib 2017)
- Initial evaluation for CRT device optimization after implantation
- Known implanted pacing device with symptoms possibly due to device complication or suboptimal pacing device settings

### **Ventricular Assist Devices (VADs) and Cardiac Transplantation**

(Doherty 2018, Stainback 2015)

- To determine candidacy for VAD
- Optimization of VAD settings and assessment of response post device
- Re-evaluation for signs/symptoms suggestive of VAD-related complications
- Monitoring for rejection in a cardiac transplant recipient

### **Adult Congenital Heart Disease**

(Baumgartner 2010, Stout 2019, Warnes 2008)

- Initial evaluation of suspected adult congenital heart disease

- Known adult congenital heart disease with a change in clinical status or cardiac exam, or to guide therapy
- Screening of first-degree relatives of patients with bicuspid or unicuspid aortic valve
- Evaluation of patients following repair of Atrial Septal Defect (ASD), Patent Foramen Ovale (PFO), Ventricular Septal Defect (VSD) or Patent Ductus Arteriosus (PDA), within the first year following correction
- Adults with Williams syndrome or patients suspected of having supravalvular stenosis should have aortic imaging with TTE, TEE, CMR, or CTA
- Asymptomatic small coronary arteriovenous fistula every 3 years
- Annual evaluation in adults after Fontan palliation
- Annual evaluation for pulmonary hypertension and Eisenmenger syndrome
- Serial follow-up based on the defect and physiological stage is summarized below (See Overview for Definitions of Physiological Stage)

<b>Diagnosis</b>	<b>Physiological Stage (follow up)</b>			
	<b>A (mo)</b>	<b>B (mo)</b>	<b>C (mo)</b>	<b>D (mo)</b>
Atrial Septal Defect	36-60	24	12	12
Ventricular Septal Defect	36	24	12	12
Atrioventricular Septal Defect	24-36	24	12	12
Patent Ductus Arteriosus	36-60	24	12	12
Congenital Mitral Stenosis	24	24	12	12
Subaortic Stenosis	24	24	12	12
Supravalvular Aortic Stenosis	24	24	12	12
Coarctation of the Aorta	24	24	12	12
Valvular Pulmonary Stenosis	36-60	24	12	12
Peripheral Pulmonary Stenosis	24-36	24	12	12
Double-Chambered Right Ventricle	24-36	24	12	12
Ebstein Anomaly	12-24	12-24	12	12
Tetralogy of Fallot	24	12-24	12	6-12
Right Ventricle-to-PA Conduit	12-24	12	12	12
d-Transposition of the Great Arteries with Atrial Switch Congenitally Corrected	12-24	12-24	12	12
Transposition of the Great Arteries	12-24	12	12	12

**PEDIATRIC PATIENTS - INDICATIONS FOR TRANSTHORACIC ECHOCARDIOGRAPHY (TTE)  
(PATIENTS UNDER THE AGE OF 18)**  
(Campbell 2014)

- Hypertension
- Renal failure
- Palpitations, if one:
  - Family history at age < 50 of either:

- Sudden cardiac death/arrest **OR**
    - Pacemaker or ICD
  - History or family history of cardiomyopathy
- Chest pain, if one or more of the following:
  - Exertional chest pain
  - Abnormal ECG
  - Family history with unexplained sudden death or cardiomyopathy
- Syncope, if any one of:
  - Abnormal ECG
  - Exertional syncope
  - Family history at age < 50 of either one:
    - Sudden cardiac death/arrest **OR**
    - Pacemaker or ICD
  - Family history of cardiomyopathy
- Signs and/or symptoms of heart failure, including, but not limited to:
  - Respiratory distress
  - Poor peripheral pulses
  - Feeding difficulty
  - Decreased urine output
  - Edema
  - Hepatomegaly
- Abnormal physical findings, including any one of:
  - Clicks, snaps, or gallops
  - Fixed and/or abnormally split S2
  - Decreased pulses.
  - Central cyanosis
- Arrhythmia, if one of:
  - Supraventricular tachycardia
  - Ventricular tachycardia
- Murmur
  - Pathologic sounding or harsh murmur, diastolic murmur, holosystolic or continuous murmur, late systolic murmur, grade 3/6 systolic murmur or louder, or murmurs that are provoked are become louder with changes in position
  - Presumptively innocent murmur, but in the presence of signs, symptoms, or findings of cardiovascular disease
- Abnormal basic data, including any one of:
  - Abnormal electrocardiogram (ECG)
  - Abnormal cardiac biomarkers
  - Desaturation on pulse oximetry
  - Abnormal chest x-ray
- Suspected pulmonary hypertension
- Signs and symptoms of endocarditis
- Thromboembolic events:
  - Patients on anticoagulants, when required to evaluate for thrombus
  - Thromboembolic events or stroke (Saric 2016)
- Systemic hematologic diseases that are associated with cardiac findings:
  - Sickle cell disease and other hemoglobinopathies

- HIV infection
- Oncologic Therapy, any one:
  - Cardiotoxic chemotherapy, before and following exposure
  - Radiation therapy to chest, before and long term follow up (Lancellotti 2013)
- Inflammatory & Autoimmune, any one:
  - Suspected Rheumatic Fever
  - Systemic lupus erythematosus
  - Takayasu Arteritis
  - Kawasaki Disease (Newburger 2004)
- Suspicion of Structural Disease, any one:
  - Premature birth where there is suspicion of a Patent Ductus Arteriosus.
  - Vascular Ring, based upon either one:
    - Difficulty breathing with stridor and eating solid foods that might suggest a vascular ring
    - Abnormal barium swallow or bronchoscopy suggesting a vascular ring
- Genetic & Syndrome Related, any one:
  - Genotype positive for cardiomyopathy, family history of hypertrophic cardiomyopathy, other heritable cardiomyopathy, genetic disorder at high risk for cardiovascular involvement, heritable pulmonary arterial hypertension
  - Patient with a known syndrome associated with congenital or acquired heart disease (Down's syndrome, Noonan's syndrome, DiGeorge syndrome, William's syndrome, Trisomy Thirteen, Trisomy Eighteen, Allagille syndrome, chromosomal abnormality associated with cardiovascular disease)
  - Abnormalities of visceral or cardiac situs
  - Known or suspected connective tissue diseases that are associated with congenital or acquired heart disease. (e.g. Marfan's, Loeys-Dietz)
  - Known or suspected muscular dystrophies associated with congenital heart disease.
  - Mitochondrial or metabolic storage disease (e.g. Fabry's disease)
  - Patients with a first degree relative with a genetic abnormality, such as cardiomyopathies (hypertrophic, dilated, arrhythmogenic right ventricular dysplasia, restrictive, left ventricular noncompaction).
- Maternal-Fetal Related, any one:
  - Maternal infection during pregnancy or delivery with potential fetal/neonatal cardiac sequelae
  - Maternal phenylketonuria
  - Suspected cardiovascular abnormality on fetal echocardiogram

## INDICATIONS FOR FOLLOW-UP ECHOCARDIOGRAPHY IN PEDIATRIC PATIENTS

(Davey 2004)

### Specific Indications for Follow-Up Echocardiograms in Pediatric Patients:

(Infancy is defined as between birth and 1 year of age; childhood from 1-11 years of age; and adolescence from 11 to 21 years of age; Hagin 2017) The guidelines for adult congenital heart disease (Stout 2018) are not intended to be used for patients under 18 years of age.

- Congenital Heart Disease (CHD) with a change in clinical status

- Kawasaki Disease, upon diagnosis, two weeks later and 4 to 6 weeks later. If any coronary abnormalities are present, echocardiograms may need to be more frequent as clinically indicated. (Newburger 2004)
- Periodic screening of children of patients with hypertrophic cardiomyopathy every 12-18 months starting by age 12 or earlier if a growth spurt or signs of puberty are evident and/or when there are plans for engaging in intensive competitive sports or there is a family history of sudden cardiac death (Gersh 2011)
- Re-evaluation annually of valvular regurgitation that is more than mild in asymptomatic child
- Pulmonic Stenosis (PS): (Mahle 2008)
  - (Peak Doppler [mm Hg]: Mild < 40, Moderate 40-60, Severe > 60)
  - Mild to moderate PS in an infant: repeat at 2 weeks and 6 weeks to assess for increasing gradient as PVR drops
  - Mild stenosis that persists after 6 weeks of age: every 6 months until age 2 years
    - If the gradient regresses to < 25 mm Hg, reduce follow up to every 5 years.
    - If the gradient remains 25 - 40 after one year, follow up in one year and then every 3 years, if stable
  - Moderate stenosis post infancy (6 weeks): every 1-2 years
  - Post intervention for severe: every year for two years, then every 3 - 5 years, if stable
- Aortic Stenosis (AS) (Van Hare 2015): (Mean Gradients [mm Hg] mild < 25, moderate 25 - 40 or maximum instantaneous gradient 40 - 70, severe > 40 or maximum instantaneous gradient > 70)
  - Mild AS in an infant: every 6 months, or more depending on the patient's clinical status and rate of progression.
  - Moderate AS in an infant: every 1 - 3 months to assess for progression and indication for valvuloplasty.
  - Mild in an asymptomatic child: every 1 - 2 years to assess for progression of stenosis
  - Moderate AS in an asymptomatic child: at least every 6 - 12 months to assess for progressive stenosis, left ventricular hypertrophy, or post-stenotic dilation.
  - In asymptomatic adolescents, annual TTE for aortic stenosis with mean Doppler gradient > 30 mm Hg or peak instantaneous gradient > 50 mm Hg, and every 2 years for patients with lesser gradients (Warnes 2008)
- Aortic valve prosthesis (Van Hare 2015)
  - Mechanical: every 6 - 12 months
  - Bioprosthetic: every 3 - 6 months
- Mitral Stenosis (MS):
  - Annual echocardiogram for MS from rheumatic heart disease in asymptomatic patient
  - Echocardiogram every 3-6 months for MS with treated CHF
- Tricuspid Stenosis (TS):
  - Frequency based on the patient's clinical course and treatment
- Shunt lesions:
  - Ventricular Septal Defect (VSD) (Rudolph 2001):
    - (Pulmonary to systemic shunt ratio: small < 1.5, moderate 1.5 - 2.3, large > 2.3) (Oakley 2008)
    - Infants with VSD: repeat echocardiogram at 2 weeks and 6 weeks to assess for increasing shunt as the PVR drops
    - Small VSD: annual echocardiogram

- Moderate to large VSD, asymptomatic: follow up in response to patient’s clinical status, if after one year, there is no pulmonary hypertension or left ventricular dilation, echo can be performed every 2 years
  - Atrial Septal Defect (ASD)
    - Moderate to large secundum ASD ( $\geq 6$  mm in diameter or shunt  $\geq 1.5:1$ ) and all primum, sinus venosus, and coronary sinus ASD: every 6 months
    - Small secundum ASD ( $< 6$  mm in diameter and shunt  $< 1.5: 1$ ): every 1 - 3 years
- 

#### **BACKGROUND:**

Transthoracic echocardiography (TTE) uses ultrasound to image the structures of the heart in a real time format, providing 2-dimensional, cross sectional images. The addition of Doppler ultrasound derives hemodynamic data from flow velocity versus time measurements, as well as from color coded two dimensional representations of flow velocities.

TTE’s safety and versatility in examining cardiac structure, function, and hemodynamics lends to its utility for numerous indications in children and adults.

TEE (transesophageal echocardiography) widens the scope of utility for echocardiographic imaging, and its indications are covered in a separate guideline.

#### **OVERVIEW:**

##### **Imaging Surveillance for Cardiotoxic Chemotherapy**

(Herrmann 2014, Maleszewski 2018, Plana 2014, Zamorano 2016)

**TTE is the method of choice** for the evaluation of patients before, during, and after cancer therapy.)

**CMR** is recommended when TTE has been unreliable and/or candidacy for cardiotoxic chemotherapy based upon LVEF is questionable (Plana 2014) (MUGA can also be considered when TTE is inadequate and CMR is not available).

**MUGA** is accurate and reproducible, but lacks information about pericardium and valves, incurs repeated radiation exposure, and is inaccurate during an irregular cardiac rhythm (Plana 2014).

##### **Cardiac Sarcoidosis** (Birnie 2014)

The most recent consensus recommendations on the criteria for diagnosis of cardiac sarcoidosis proposed by the Heart Rhythm Society is provided below.

There are 2 pathways to a diagnosis of Cardiac Sarcoidosis:

1. Histological Diagnosis from Myocardial Tissue

CS is diagnosed in the presence of non-caseating granuloma on histological examination of myocardial tissue with no alternative cause identified (including negative organismal stains if applicable).

2. Clinical Diagnosis from Invasive and Non-Invasive Studies:

It is probable\* that there is CS if:

a) There is a histological diagnosis of extra-cardiac sarcoidosis

*and*

b) One or more of following is present

- Steroid +/- immunosuppressant responsive cardiomyopathy or heart block
- Unexplained reduced LVEF (< 40%)
- Unexplained sustained (spontaneous or induced) VT
- Mobitz type II 2nd degree heart block or 3rd degree heart block
- Patchy uptake on dedicated cardiac PET (in a pattern consistent with CS)
- Late Gadolinium Enhancement on CMR (in a pattern consistent with CS)
- Positive gallium uptake (in a pattern consistent with CS)

*and*

c) Other causes for the cardiac manifestation(s) have been reasonably excluded

\*In general, 'probable involvement' is considered adequate to establish a clinical diagnosis of CS.<sup>33</sup>

## Adult Congenital Heart Disease (Stout 2018)

### Physiologic Stages in CHD

Physiological Stage
<b>A</b>
<ul style="list-style-type: none"><li>■ NYHA FC I symptoms</li><li>■ No hemodynamic or anatomic sequelae</li><li>■ No arrhythmias</li><li>■ Normal exercise capacity</li><li>■ Normal renal/hepatic/pulmonary function</li></ul>
<b>B</b>
<ul style="list-style-type: none"><li>■ NYHA FC II symptoms</li><li>■ Mild hemodynamic sequelae (mild aortic enlargement, mild ventricular enlargement, mild ventricular dysfunction)</li><li>■ Mild valvular disease</li><li>■ Trivial or small shunt (not hemodynamically significant)</li><li>■ Arrhythmia not requiring treatment</li><li>■ Abnormal objective cardiac limitation to exercise</li></ul>
<b>C</b>
<ul style="list-style-type: none"><li>■ NYHA FC III symptoms</li><li>■ Significant (moderate or greater) valvular disease; moderate or greater ventricular dysfunction (systemic, pulmonic, or both)</li><li>■ Moderate aortic enlargement</li><li>■ Venous or arterial stenosis</li><li>■ Mild or moderate hypoxemia/cyanosis</li><li>■ Hemodynamically significant shunt</li><li>■ Arrhythmias controlled with treatment</li><li>■ Pulmonary hypertension (less than severe)</li><li>■ End-organ dysfunction responsive to therapy</li></ul>
<b>D</b>
<ul style="list-style-type: none"><li>■ NYHA FC IV symptoms</li><li>■ Severe aortic enlargement</li><li>■ Arrhythmias refractory to treatment</li><li>■ Severe hypoxemia (almost always associated with cyanosis)</li><li>■ Severe pulmonary hypertension</li><li>■ Eisenmenger syndrome</li><li>■ Refractory end-organ dysfunction</li></ul>

\*This list is not meant to be comprehensive; other conditions may be important in individual patients.

ACHD indicates adult congenital heart disease; AP, anatomic and physiological; ASD, atrial septal defect; AVSD, atrioventricular septal defect; CCTGA, congenitally corrected transposition of the great arteries; CHD, congenital heart disease; d-TGA, dextro-transposition of the great arteries; FC, functional class; HCM, hypertrophic cardiomyopathy; l-TGA, levo-transposition of the great arteries; NYHA, New York Heart Association; TGA, transposition of the great arteries; and VSD, ventricular septal defect.

## General Information on TTE

(Campbell 2014, Doherty 2017, Douglas 2011, Nishimura 2014)

### Pediatric Post-Operative Patients

Congenital heart disease, which requires surgical palliation, is, by its very nature, quite varied. No written consensus criteria currently exist for monitoring post-operative patients, but rather is based upon the clinical experience and training of the pediatric cardiologists caring for the patient. Criteria for performing an echocardiogram in the out-patient setting will vary greatly based upon whether the patient has a complex lesion, which must be repaired in stages, had post-operative complications, or is on medications which will be weaned over the ensuing weeks.

### TTE versus TEE

Specific situations where transesophageal echocardiography (TEE) is preferred over TTE and may be an appropriate initial study include the evaluation of a prosthetic device, suspected peri-annular complications, children with complex congenital cardiac lesions, selected patients with *Staphylococcus aureus* bacteremia, etc. Visualization of left atrial thrombus is far superior with TEE, which is the recommended strategy.

### Abbreviations

ASD	Atrial septal defect
CABG	Coronary artery bypass grafting surgery
CAD	Coronary artery disease
CMR	Cardiovascular magnetic resonance
CRT	Cardiac resynchronization therapy
CT	Computed tomography
ECG	Electrocardiogram
HCM	Hypertrophic cardiomyopathy
HF	Heart failure
ICD	Implantable cardioverter-defibrillator
LV	Left ventricular
LVEF	Left ventricular ejection fraction
MI	Myocardial infarction
PDA	Patent ductus arteriosus
PFO	Patent foramen ovale
SVT	Supraventricular tachycardia
TAVR	Transcatheter aortic valve replacement
TEE	Transesophageal echocardiogram
TIA	Transient ischemic attack
Tn	Troponin
TTE	Transthoracic echocardiogram
PVC	Ventricular premature contraction
VSD	Ventricular septal defect
VT	Ventricular tachycardia

## POLICY HISTORY:

**Review Date:** August 14, 2019

### Review Summary:

- Added indication for hypotension of suspected cardiac etiology
- Removed indication for respiratory failure or hypoxemia of uncertain etiology
- Clarified palpitations indication with “symptoms or signs of cardiovascular disease (i.e. abnormal physical exam or ECG)”
- Clarification of murmur indication with “when there is a reasonable suspicion of valvular heart disease such as high grade, holosystolic, continuous, or diastolic murmur”
- Clarified frequent PVCs as greater than 30 per hour
- Added indication for unevaluated left bundle branch block
- Added indication for exercise induced syncope
- For perioperative evaluation for solid organ transplantation, added annual study prior to transplantation
- Removed indication for re-evaluation (<1 yr) in patients with moderate or severe aortic stenosis, who will be subjected to increased hemodynamic demands (e.g. noncardiac surgery, pregnancy)
- Removed tertiary syphilis or Takayasu’s Arteritis indication
- Pulmonary hypertension:
  - Clarified re-evaluation for a change in clinical status or cardiac exam, or to guide therapy (every 6 - 12 months, or more frequently to guide therapy). Annual indication removed.
  - Screening for scleroderma added
- Removed indications for history of rheumatic heart disease and exposure to medications that could result in valvular heart disease
- Added mild valvular regurgitation as an indication for testing every 3 years
- Added indication for annual evaluation of prosthetic heart valves older than 10 years
- In depth indications for HOCM
- LVAD and transplant indications added
- Removed chart on specific chemotherapeutic agents
- Added detailed indications for adult congenital heart disease and serial follow up
- Removed indications for presyncope for pediatric patients
- Revised murmur indication in pediatric patients with more criteria for pathologic murmur
- Added definitions of age groups for pediatric patients (infancy, childhood, and adolescence)

November 2019

- Added CPT code +93356

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