National Imaging Associates, Inc.	
Clinical guidelines **TRANSTHORACIC (TTE) ECHO**	**Original Date: October 26, 2009** **Page 1 of 12**
CPT codes: 93303, 93304, 93306, 93307, 93308, +93320, +93321, +93325	**Last Review Date: March 2014**
Guideline Number: NIA_CG_067	**Last Revised Date: March 2014**
Responsible Department: **Clinical Operations**	**Implementation Date: March 2014**

INTRODUCTION:

Echocardiography also known as 'cardiac ultrasound' is a diagnostic test that uses ultrasound waves to create an image of the heart muscle. Ultrasound waves that rebound or echo off the heart can show the size, shape, and movement of the heart's valves and chambers as well as the flow of blood through the heart.

Transthoracic Echocardiograms (TTE) are used to evaluate structural heart disease, ventricular function and valve function. In children and small adults TTE provides accurate anatomic definition of most congenital heart diseases. Coupled with Doppler hemodynamic measurements, Transthoracic Echocardiograms (TTE) usually provides accurate diagnosis and noninvasive serial assessment. Transesophageal echocardiogram (TEE) is an alternative way to perform an echocardiogram where the probe is passed into patient's esophagus. (See separate guideline on TEE.)

Indications for pediatric patients are presented first followed by indications for adult patients.

<u>PEDIATRIC PATIENTS (PATIENTS UNDER THE AGE OF 18):</u>

INDICATIONS FOR A TRANSTHORACIC ECHOCARDIOGRAPHY (TTE) FOR PEDIATRIC PATIENTS:

- A heart murmur (harsh murmur, diastolic murmur, or continuous murmur) present in such a way as to have a reasonable belief that congenital heart disease might be present.
- Chest pain upon presentation that is not obviously non-cardiac.
- Syncope that is not clearly vasovagal syncope.
- Clearly abnormal ECG.
- Abnormal cardiac structure on a chest x-ray.
- Signs and/or symptoms of heart failure.
- Abnormal physical findings, including clicks, snaps, gallops, a fixed and/or split S2, and decreased pulses.
- Arrhythmia/palpitations, for evaluation of structural heart disease.
- Syndromic patients with a known syndrome associated with congenital or acquired heart disease (Downs syndrome, Noonans syndrome, 22Q deficiency syndrome, Williams syndrome, Trisomy Thirteen, Trisomy Eighteen, Allagille syndrome).
- Failed Pulse oximetry test for any newborn.

- Known or suspected connective tissue diseases that are associated with congenital or acquired heart disease.
- Known or suspected muscular dystrophies associated with congenital heart disease.
- Exposure to anthracycline medications generally in relation to chemotherapy.
- Premature birth where there is suspicion of a Patent Ductus Arteriosus.
- Kawasaki Disease.
- Suspected Rheumatic Fever.
- Family history of sudden death related to a finding that could be present on an echocardiogram.
- Adopted children for whom there is a suspicion of congenital heart disease (e.g. HCM), based on physical or clinical findings when there is a lack of family history information.
- Cyanotic patients without explanation.
- Suspicion of a fetal abnormality.
- Difficulty breathing with stridor and eating solid foods that might suggest a vascular ring.
- Hypertension.
- Known or suspected endocarditis, including all patients with an indwelling catheter who present with unexplained fever.
- Patients on anticoagulants (to evaluate for thrombus).
- Patients with prosthetic valves.
- Systemic diseases that are associated with cardiac findings, such as connective tissue diseases, sickle cell disease, and HIV infection.
- Patients with a first degree relative who is known to have a genetic acquisition, such as cardiomyopathies (HCM,DCM,ARVD/C,RCM, and LVNC).
- Thromboembolic events.
- Suspected pulmonary hypertension.
- Ventricular pre-excitation with no clinical or holter findings to suggest an arrhythmia, but with suspicion of Ebsteins anomaly, Tumors, HCM or clinical signs of heart failure.

INDICATIONS FOR POSTOPERATIVE/POST-PROCEDURE PEDIATRIC PATIENTS:

- Upon first outpatient visit, to establish the patient's new hemodynamic baseline, and assess for potential complications such as pericardial effusions, residual shunts, obstruction at the site of repair, patency of surgical shunts, etc.
- On subsequent visits as needed to monitor as medications are weaned or to evaluate need for further surgical intervention.

INDICATIONS FOR FOLLOW-UP ECHOCARDIOGRAMS FOR PEDIATRIC PATIENTS:

- 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.
- Valvular regurgitation that is more than mild in asymptomatic child may require annual echocardiogram to assess chamber size and progressive regurgitation.

- Valvular stenosis:
  - Pulmonic Stenosis (PS):
    - Mild to moderate PS in an infant: repeat at 2 weeks and 6 weeks to assess for increasing gradient as PVR drops.
    - Moderate PS in an infant: every 1-3 months for on-going surveillance after the 6-week study.
    - Mild PS in asymptomatic child: every 2-3 years to assess for progression of stenosis.
    - Moderate to severe: annually to assess for progression of stenosis and development of RVH.
  - Aortic Stenosis (AS):
    - Mild AS in an infant: every 6 months, or more depending on the patient's clinical status and rate of progression.
    - Mild in an asymptomatic child: every 1-2 years to assess for progression of stenosis.
    - Moderate AS in an infant: every 1-3 months to assess for progression and indication for valvuloplasty.
    - Moderate to severe AS: at least every 6-12 months to assess for progressive stenosis, LVH, post-stenotic dilation.
  - Mitral Stenosis (MS):
    - MS from Rheumatic Heart Disease on no meds with no symptoms may require an annual echocardiogram.
    - MS with CHF on medications may require an echocardiogram every three to 6 months.
  - Tricuspid Stenosis (TS):
    - A rare indication that would be based on the patient's course of treatment and clinical symptoms.
- Shunt lesions:
  - Ventricular Septal Defect (VSD):
    - Infants with VSD: repeat echocardiogram at 2 weeks and 6 weeks to assess for increasing shunt as the PVR drops.
    - Small VSD: annual echocardiogram to assess for associated lesions depending on location of defect, i.e. aortic regurgitation, development of DCRV.
    - Moderate to large VSD: Close follow up in response to patient's clinical status, to assess for LV dilation, mitral regurgitation, associated lesions.
  - Atrial Septal Defect (ASD):
    - Moderate to large ASD: at 6 months intervals to assess for progressive RV dilation, tricuspid regurgitation.
    - Small ASD: every 1-3 years, depending on age of patient.

NOT INDICATED unless there is treating physician input during a peer-to-peer discussion that supports the need for an echocardiogram.

- Chest pain that changes with inspiration.
- Clear Orthostatic Hypotension.
- Chest pain that increases upon palpation.
- High cholesterol/triglycerides in children who have no other indication for an echocardiogram.
- Isolated prolonged QT syndrome with no clinical or holter evidence of an arrhythmia or other physical findings.

NOT INDICATED:

- Attention Deficit Disorder with no other relevant findings.
- A sports physical with normal history, physical and ECG.
- Parental request as the sole reason for an echocardiogram.
- All patients with a 1st degree relative with an inherited form of cardiomyopathy where the patient has been definitively excluded by genetic testing.

See "Additional Information" below

ADULT PATIENTS

INDICATIONS FOR A TRANSTHORACIC ECHOCARDIOGRAPHY (TTE):

ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Transthoracic Echocardiography (TTE)

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain
	General Evaluation of Cardiac Structure and Function	
	Suspected Cardiac Etiology—General With TTE	
1	• Symptoms or conditions potentially related to suspected cardiac etiology including but not limited to chest pain, shortness of breath, palpitations, TIA, stroke, or peripheral embolic event	**A(9)**
2	• Prior testing that is concerning for heart disease or structural abnormality including but not limited to chest X-ray, baseline scout images for stress echocardiogram, ECG, or cardiac biomarkers	**A(9)**

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain
	Arrhythmias With TTE	
4	• Frequent VPCs or exercise-induced VPCs	**A(8)**
5	• Sustained or nonsustained atrial fibrillation, SVT, or VT	**A(9)**
	Lightheadedness/Presyncope/Syncope With TTE	
7	• Clinical symptoms or signs consistent with a cardiac diagnosis known to cause lightheadedness / presyncope / syncope (including but not limited to aortic stenosis, hypertrophic cardiomyopathy, or HF)	**A(9)**
9	• Syncope when there are no other symptoms or signs of cardiovascular disease	**A(7)**
	Perioperative Evaluation With TTE	
14	• Routine perioperative evaluation of cardiac structure and function prior to noncardiac solid organ transplantation	**U(6)**
	Pulmonary Hypertension With TTE	
15	• Evaluation of suspected pulmonary hypertension including evaluation of right ventricular function and estimated pulmonary artery pressure	**A(9)**
17	• Routine surveillance (≥1 y) of known pulmonary hypertension without change in clinical status or cardiac exam	**A(7)**
18	• Re-evaluation of known pulmonary hypertension if change in clinical status or cardiac exam or to guide therapy	**A(9)**
	TTE for Evaluation of Valvular Function	
	Murmur or Click With TTE	
34	• Initial evaluation when there is a reasonable suspicion of valvular or structural heart disease	**A(9)**
37	• Re-evaluation of known valvular heart disease with a change in clinical status or cardiac exam or to guide therapy	**A(9)**

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain
	Native Valvular Stenosis With TTE	
39	• Routine surveillance (≥3 y) of mild valvular stenosis without a change in clinical status or cardiac exam	**A(7)**
41	• Routine surveillance (≥1 y) of moderate or severe valvular stenosis without a change in clinical status or cardiac exam	**A(8)**
	Native Valvular Regurgitation With TTE	
44	• Routine surveillance (≥3 y) of mild valvular regurgitation without a change in clinical status or cardiac exam	**U(4)**
45	• Routine surveillance (<1 y) of moderate or severe valvular regurgitation without a change in clinical status or cardiac exam	**U(6)**
46	• Routine surveillance (≥1 y) of moderate or severe valvular regurgitation without change in clinical status or cardiac exam	**A(8)**
	Prosthetic Valves With TTE	
47	• Initial postoperative evaluation of prosthetic valve for establishment of baseline	**A(9)**
49	• Routine surveillance (≥3 y after valve implantation) of prosthetic valve if no known or suspected valve dysfunction	**A(7)**
50	• Evaluation of prosthetic valve with suspected dysfunction or a change in clinical status or cardiac exam	**A(9)**
51	• Re-evaluation of known prosthetic valve dysfunction when it would change management or guide therapy	**A(9)**
	Infective Endocarditis (Native or Prosthetic Valves) With TTE	
52	• Initial evaluation of suspected infective endocarditis with positive blood cultures or a new murmur	**A(9)**
55	• Re-evaluation of infective endocarditis at high risk for progression or complication or with a change in clinical status or cardiac exam	**A(9)**

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain
	TTE for Evaluation of Intracardiac and Extracardiac Structures and Chambers	
57	• Suspected cardiac mass	**A(9)**
58	• Suspected cardiovascular source of embolus	**A(9)**
59	• Suspected pericardial conditions	**A(9)**
61	• Re-evaluation of known pericardial effusion to guide management or therapy	**A(8)**
62	• Guidance of percutaneous noncoronary cardiac procedures including but not limited to pericardiocentesis, septal ablation, or right ventricular biopsy	**A(9)**
	TTE for Evaluation of Aortic Disease	
63	• Evaluation of the ascending aorta in the setting of a known or suspected connective tissue disease or genetic condition that predisposes to aortic aneurysm or dissection (e.g., Marfan syndrome)	**A(9)**
64	• Re-evaluation of known ascending aortic dilation or history of aortic dissection to establish a baseline rate of expansion or when the rate of expansion is excessive	**A(9)**
65	• 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 or therapy	**A(9)**
	TTE for Evaluation of Hypertension, HF, or Cardiomyopathy	
	Hypertension With TTE	
67	• Initial evaluation of suspected hypertensive heart disease	**A(8)**
69	• Re-evaluation of known hypertensive heart disease without a change in clinical	**U(4)**

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain
	status or cardiac exam	
	HF With TTE	
70	• Initial evaluation of known or suspected HF (systolic or diastolic) based on symptoms, signs, or abnormal test results	**A(9)**
71	• 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	**A(8)**
72	• Re-evaluation of known HF (systolic or diastolic) with a change in clinical status or cardiac exam with a clear precipitating change in medication or diet	**U(4)**
73	• Re-evaluation of known HF (systolic or diastolic) to guide therapy	**A(9)**
75	• Routine surveillance (≥1 y) of HF (systolic or diastolic) when there is no change in clinical status or cardiac exam	**U(6)**
	Device Evaluation (Including Pacemaker, ICD, or CRT) With TTE	
76	• Initial evaluation or re-evaluation after revascularization and/or optimal medical therapy to determine candidacy for device therapy and/or to determine optimal choice of device	**A(9)**
77	• Initial evaluation for CRT device optimization after implantation	**U(6)**
78	• Known implanted pacing device with symptoms possibly due to device complication or suboptimal pacing device settings	**A(8)**
	Ventricular Assist Devices and Cardiac Transplantation With TTE	
81	• To determine candidacy for ventricular assist device	**A(9)**
82	• Optimization of ventricular assist device settings	**A(7)**
83	• Re-evaluation for signs/symptoms	**A(9)**

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain
	suggestive of ventricular assist device-related complications	
84	• Monitoring for rejection in a cardiac transplant recipient	**A(7)**
85	• Cardiac structure and function evaluation in a potential heart donor	**A(9)**
	Cardiomyopathies With TTE	
86	• Initial evaluation of known or suspected cardiomyopathy (e.g., restrictive, infiltrative, dilated, hypertrophic, or genetic cardiomyopathy	**A(9)**
87	• Re-evaluation of known cardiomyopathy with a change in clinical status or cardiac exam or to guide therapy	**A(9)**
89	• Routine surveillance (≥1 y) of known cardiomyopathy without a change in clinical status or cardiac exam	**U(5)**
90	• Screening evaluation for structure and function in first-degree relatives of a patient with an inherited cardiomyopathy	**A(9)**
91	• Baseline and serial re-evaluations in a patient undergoing therapy with cardiotoxic agents	**A(9)**
	TTE for Adult Congenital Heart Disease	
92	• Initial evaluation of known or suspected adult congenital heart disease	**A(9)**
93	• Known adult congenital heart disease with a change in clinical status or cardiac exam	**A(9)**
94	• Re-evaluation to guide therapy in known adult congenital heart disease.	**A(9)**
96	• Routine surveillance (≥2 y) of adult congenital heart disease following complete repair ○ without residual structural or hemodynamic abnormality ○ without a change in clinical status or cardiac exam	**U(6)**

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (4-9); A= Appropriate; U=Uncertain
97	• Routine surveillance (<1 y) of adult congenital heart disease following incomplete or palliative repair ○ with residual structural or hemodynamic abnormality ○ without a change in clinical status or cardiac exam	**U(5)**
98	• Routine surveillance (≥1 y) of adult congenital heart disease following incomplete or palliative repair ○ with residual structural or hemodynamic abnormality ○ without a change in clinical status or cardiac exam	**A(8)**

ADDITIONAL INDICATION:

- For evaluation of asymptomatic patients following repair of Atrial Septal Defect (ASD), Patent Foramen Ovale (PFO), Ventricular Septal Defect (VSD) or Patent Ductus Arteriosus (PDA), follow-up examination is only indicated within the first year following correction.

ACC GUIDELINES WITH "INAPPROPRIATE" DESIGNATION:

Requests that meet ACCF/ASNC Inappropriate use score of (1-3) noted below OR meet any one of the following are not approvable:

- For same imaging test less than 52 weeks (1 year) apart unless specific guideline criteria states otherwise.
- For different imaging tests of same anatomical structure but different imaging type less than six (6) weeks (such as Heart MRI/CT) unless specific guideline criteria states otherwise (i.e. CT/MRI and now wants Echocardiogram) without high level review to evaluate for medical necessity.
- Additional images for same-study (poor quality, etc).

ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Transthoracic Echocardiography (TTE):

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (1-3); I= Inappropriate
	General Evaluation of Cardiac Structure and Function	
	Arrhythmias With TTE	
3	• Infrequent APCs or infrequent VPCs without other evidence of heart disease	**I(2)**
6	• Asymptomatic isolated sinus bradycardia	**I(2)**
	Lightheadedness/Presyncope/Syncope With TTE	
8	• Lightheadedness/presyncope when there are no other symptoms or signs of cardiovascular disease	**I(3)**
	Evaluation of Ventricular Function	
10	• Initial evaluation of ventricular function (e.g., screening) with no symptoms or signs of cardiovascular disease	**I(2)**
11	• Routine surveillance of ventricular function with known CAD and no change in clinical status or cardiac exam	**I(3)**
12	• Evaluation of LV function with prior ventricular function evaluation showing normal function (e.g., prior echocardiogram, left ventriculogram, CT, SPECT MPI,CMR) in patients in whom there has been no change in clinical status or cardiac exam	**I(1)**
	Perioperative Evaluation With TTE	
13	• Routine perioperative evaluation of ventricular function with no symptoms or signs of cardiovascular disease transplantation	**I(2)**
	Pulmonary Hypertension With TTE	
16	• Routine surveillance (<1 y) of known pulmonary hypertension without	**I(3)**

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (1-3); I= Inappropriate
	change in clinical status or cardiac exam	
	TTE for Evaluation of Valvular Function	
	Murmur or Click With TTE	
35	• Initial evaluation when there are no other symptoms or signs of valvular or structural heart disease	**I(2)**
36	• Re-evaluation in a patient without valvular disease on prior echocardiogram and no change in clinical status or cardiac exam	**I(1)**
	Native Valvular Stenosis With TTE	
38	• Routine surveillance (≥3 y) of mild valvular stenosis without a change in clinical status or cardiac exam	**I(3)**
40	• Routine surveillance (≥1 y) of moderate or severe valvular stenosis without a change in clinical status or cardiac exam	**I(3)**
	Native Valvular Regurgitation With TTE	
42	• Routine surveillance of trace valvular regurgitation	**I(1)**
43	• Routine surveillance (<3 y) of mild valvular regurgitation without a change in clinical status or cardiac exam	**I(2)**
	Prosthetic Valves With TTE	
48	• Routine surveillance (<3 y after valve implantation) of prosthetic valve if no known or suspected valve dysfunction	**I(3)**
	Infective Endocarditis (Native or Prosthetic Valves) With TTE	
53	• Transient fever without evidence of bacteremia or a new murmur	**I(2)**
54	• Transient bacteremia with a pathogen not typically associated with infective endocarditis and/or a documented nonendovascular source of infection	**I(3)**

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (1-3); I= Inappropriate
56	• Routine surveillance of uncomplicated infective endocarditis when no change in management is contemplated	**I(2)**
	TTE for Evaluation of Intracardiac and Extracardiac Structures and Chambers	
60	• Routine surveillance of known small pericardial effusion with no change in clinical status	**I(2)**
	TTE for Evaluation of Aortic Disease	
66	• Routine re-evaluation for surveillance of known ascending aortic dilation or history of aortic dissection without a change in clinical status or cardiac exam when findings would not change management or therapy	**I(3)**
	TTE for Evaluation of Hypertension, HF, or Cardiomyopathy	
	Hypertension With TTE	
68	• Routine evaluation of systemic hypertension without symptoms or signs of hypertensive heart disease	**I(3)**
	HF With TTE	
74	• Routine surveillance (<1 y) of HF (systolic or diastolic) when there is no change in clinical status or cardiac exam	**I(2)**
	Device Evaluation (Including Pacemaker, ICD, or CRT) With TTE	
79	• Routine surveillance (<1 y) of implanted device without a change in clinical status or cardiac exam	**I(1)**
80	• Routine surveillance (≥1 y) of implanted device without a change in clinical status or cardiac exam	**I(3)**
	Cardiomyopathies With TTE	
88	• Routine surveillance (<1 y) of known cardiomyopathy without a change in clinical status or cardiac exam	**I(2)**

ACCF et al. Criteria # TTE (Indication and Appropriate Use Score)	INDICATIONS	APPROPRIATE USE SCORE (1-3); I= Inappropriate
	TTE for Adult Congenital Heart Disease	
95	Routine surveillance (<2 y) of adult congenital heart disease following complete repair o without a residual structural or hemodynamic abnormality o without a change in clinical status or cardiac exam	**I(3)**

ADDITIONAL INFORMATION:

Pediatric Post-Operative Patients:
Congenital heart disease, which requires surgical palliation, is, by its very nature, quite varied. No written consensus criteria currently exists 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.

Murmurs:
A harsh murmur, diastolic murmur, or continuous murmur would be an indication for an echocardiogram. Soft systolic murmurs and vibratory murmurs in general would not be indications for an echocardiogram. There is an important caveat in regards to age. Existent literature suggests that young children particularly under the age of three can have what appear to be unremarkable murmurs that result in organic heart disease even when examined by experts. Great leeway should therefore be given when echocardiograms are performed under the age of 3 years.

TTE Accuracy:
In general, transthoracic echocardiography (TTE) is adequate for diagnosing IE and for identifying vegetations in cases where cardiac structures-of-interest are well visualized. Contemporary TTE has improved the diagnostic accuracy of infective endocarditis by ameliorating image quality; it provides an accurate assessment of endocarditis and may reduce the need for TEE. However accuracy may be reduced because of technical difficulties like obesity, chronic obstructive pulmonary disease, chest-wall deformities etc.

TTE versus TEE:
Specific situations where transesophageal echocardiography (TEE) is preferred over TTE and may be an appropriate initial study for evaluation of prosthetic device, suspected periannular complications, children with complex congenital cardiac lesions, selected patients with Staphylococcus aureus bacteremia, and certain pre-existing valvular abnormalities that make TTE interpretation problematic (e.g., calcific aortic stenosis).
Transthoracic echocardiography is a valuable tool in the perioperative period.

Abbreviations

ACS = acute coronary syndrome
APC = atrial premature contraction
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
HF = heart failure
ICD = implantable cardioverter-defibrillator
LBBB = left bundle-branch block
LV = left ventricular
MET = estimated metabolic equivalents of exercise
MI = myocardial infarction
PCI = percutaneous coronary intervention
PDA = patent ductus arteriosus
PFO = patent foramen ovale
RNI = radionuclide imaging
SPECT MPI = single-photon emission computed tomography myocardial perfusion imaging
STEMI = ST-segment elevation myocardial infarction
SVT = supraventricular tachycardia
TEE = transesophageal echocardiogram
TIA = transient ischemic attack
TIMI = Thrombolysis In Myocardial Infarction
TTE = transthoracic echocardiogram
UA/NSTEMI = unstable angina/non–ST-segment elevation myocardial infarction
VPC = ventricular premature contraction
VSD = ventricular septal defect
VT = ventricular tachycardia

REFERENCES

ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Echocardiography. *J Am Coll Cardiol,* doi:10.1016/j.jacc.2010.11.002. Retrieved from http://content.onlinejacc.org/cgi/reprint/j.jacc.2010.11.002v1.pdf

Armstrong, W.F., & Zoghbi, W.A. (2005 June). Stress Echocardiography: Current methodology and clinical applications. *J Am Coll Cardiol. 45(11),* 1739-1747. Retrieved from http://www.sciencedirect.com/science/article/pii/S0735109705005346

Ballo, P., Bandini, F., Capecchi, I., Chiodi, L., Ferro, G., Fortini, A., . . . Zuppiroli, A. (2012). Application of 2011 American College of Cardiology Foundation/American Society of echocardiography appropriateness use criteria in hospitalized patients referred for transthoracic echocardiography in a community setting. *Journal of The American Society of Echocardiography: Official Publication of The American Society of Echocardiography*, *25*(6), 589-598. Retrieved from http://www.unboundmedicine.com/medline/ebm/record/22560735/abstract/Application_of_2011_American_College_of_Cardiology_Foundation/American_Society_of_Echocardiography_Appropriateness_Use_Criteria_in_Hospitalized_Patients_Referred_for_Transthoracic_Echocardiography_in_a_Community_Setting_

Cowie, B.S. (2010 September). Focused transthoracic echocardiography in the perioperative period. *Anaesth Intensive Care. 38(5),* 823-36. Retrieved from http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=16&hid=19&sid=82ebaec3-bf12-4595-b4fd-3945f7e612a8%40sessionmgr12

Davey, B.T., Vogel, R.L., Cohen, M.S., Fogel, M.A. & Paridon, S.M. (2004). Cardiac testing. In Gleason, M.M., Rychik, J., & Shaddy, R.E. (Authors), *Pediatric Practice Cardiology. (*pp.23-60). New York: The McGraw-Hill Companies. ISBN 978-0-07-176320-2.

Kini, V., Logani, S., Ky, B., Chirinos, J. A., Ferrari, V. A., St. John Sutton, M.G., . . . Kirkpatrick, J.N. (2010, April). Transthoracic and transesophageal echocardiography for the indication of suspected infective endocarditis: Vegetations, blood cultures and imaging. *J Am Soc Echocardiogaphyr, 23(4),* 396-402. Retrieved from http://www.onlinejase.com/article/S0894-7317(09)01203-6/fulltext

Newburger, J.W., Takahashi, M., Gerber, M.A., Gewitz, M.H., Tani, L.Y., Burns, J.C., Shulman, S.T. . . . Taubert, K.A. (2004). AHA Scientific Statement. Diagnosis, treatment, and long-term management of Kawasaki Disease. *Circulation*, 110. 2747-2771. doi: 10.1161/ 01.CIR.0000145143.19711.78.

Parikh, P., Asheld, J., & Kort, S. (2012). Does the revised appropriate use criteria for echocardiography represent an improvement over the initial criteria? A comparison between the 2011 and the 2007 appropriateness use criteria for echocardiography. *Journal*

of The American Society of Echocardiography: Official Publication of The American Society of Echocardiography, *25*(2), 228-233. Retrieved from http://www.onlinejase.com/article/S0894-7317(11)00723-1/abstract

Patil, H., Coggins, T., Kusnetzky, L., & Main, M. (2012). Evaluation of appropriate use of transthoracic echocardiography in 1,820 consecutive patients using the 2011 revised appropriate use criteria for echocardiography. *The American Journal of Cardiology*, *109*(12), 1814-1817. Retrieved from http://www.ajconline.org/article/S0002-9149(12)00702-3/abstract

Pellikka, P.A., Nagueh, S.F., Elhenda, A.A., Kuehl, C.A., & Sawada, S.G. (2007). American Society of Echocardiography recommendations for performance, interpretation, and application of stress echocardiography. *Journal of the American Society of Echocardiography: Official Publication of the American Society of Echocardiography*. *20(9),* 1021-1041. Retrieved from http://www.suc.org.uy/emcc2008/Curso_Imag_2008_archivos/Bibliografia/Ecoestres/Guias%20STRESS%20ASECHO_2007.pdf

Reviewed/Approved by Michael Pentecost, MD, Associate Chief Medical Officer