

Appendix A: TTE/TEE Second Round Ratings

Indication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree	
Table 1. General Evaluation of Structure and Function																				
Suspected Cardiac Etiology - General																				
1	Symptoms potentially due to suspected cardiac etiology, including but not limited to dyspnea, shortness of breath, lightheadedness, syncope, TIA, cerebrovascular events.	9	9	9	9	8	9	8	9	7	8	7	9	8	9	8	9	0.6	A	+
2	Prior testing that is concerning for heart disease (i.e. chest x-ray, baseline scout images for stress echocardiogram, electrocardiogram, elevation of serum BNP)	9	7	9	9	8	9	8	8	7	8	6	9	8	9	9	8	0.7	A	+
Adult Congenital Heart Disease																				
3	Assessment of known or suspected adult congenital heart disease including anomalies of great vessels, and cardiac chambers and valves or suspected intracardiac shunt (ASD, VSD, PDA) either in unoperated patient or following repair/operation	9	9	9	9	9	9	9	9	7	9	9	9	9	9	9	9	0.1	A	+
4	Routine (yearly) evaluation of asymptomatic patients with corrected ASD, VSD or PDA more than one year after successful correction	1	2	4	3	3	2	3	2	3	6	1	1	1	3	3	3	1.0	I	+
Arrhythmias																				
5	Patients who have isolated APC or PVC without other evidence of heart disease	2	7	3	2	3	2	4	5	2	2	1	1	5	5	2	2	1.3	I	+
6	Patients who have sustained or non sustained SVT or VT	8	9	8	8	7	9	8	8	7	8	7	5	8	9	9	8	0.7	A	+
LV Function Evaluation																				
7	Evaluation of LV function with prior ventricular function evaluation within the past year with normal function (such as prior echocardiogram, LV gram, SPECT, cardiac MRI) in patients in whom there has been no change in clinical status	2	1	2	3	1	1	2	3	2	2	1	1	1	2	3	2	0.6	I	+

Indication		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree	
8	Initial evaluation of LV function following acute myocardial infarction	9	9	9	9	6	9	9	9	8	9	9	9	9	9	9	9	0.3	A	+	
9	Re-evaluation of LV function following myocardial infarction during recovery phase when results will guide therapy	8	9	8	7	6	9	8	9	7	8	5	9	9	7	9	8	0.9	A	+	
Pulmonary Hypertension																					
10	Evaluation of known or suspected pulmonary hypertension including evaluation of right ventricular function and estimated pulmonary artery pressure	9	9	9	9	7	9	8	8	7	8	7	8	9	8	9	8	0.7	A	+	
Table 2. Cardiovascular Evaluation in an Acute Setting																					
Hypotension or Hemodynamic Instability																					
11	Evaluation of hypotension or hemodynamic instability of uncertain or suspected cardiac etiology	9	9	9	9	7	9	8	9	8	8	8	9	7	9	9	9	0.5	A	+	
Myocardial Ischemia/Infarction																					
12	Evaluation of acute chest pain with suspected myocardial ischemia in patients with nondiagnostic laboratory markers and ECG and in whom a resting echocardiogram can be performed during pain	8	9	9	9	8	8	9	9	7	8	8	8	8	8	9	8	0.5	A	+	
13	Evaluation of suspected complication of myocardial ischemia/infarction, including but not limited to acute mitral regurgitation, hypoxemia, abnormal chest x-ray, VSD, free wall rupture/tamponade, shock, right ventricular involvement, heart failure, or thrombus	9	9	9	9	8	9	9	9	9	9	9	9	9	9	9	9	0.1	A	+	
Respiratory Failure																					
14	Evaluation of respiratory failure with suspected cardiac etiology	9	9	9	9	8	8	8	8	8	8	8	9	8	9	8	8	0.4	A	+	
Pulmonary Embolism																					
15	Initial evaluation of patient with suspected pulmonary embolism in order to establish diagnosis	8	3	4	3	5	6	2	7	5	5	1	1	1	3	2	3	1.8	I		
16	Evaluation of patient with known or suspected acute pulmonary embolism to guide therapy (i.e. thrombectomy and thrombolytics)	8	9	8	8	7	8	6	8	6	9	7	9	8	8	9	8	0.7	A	+	

Indication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree	
Table 3. Evaluation of Valvular Function																				
Murmur																				
17	Initial evaluation of murmur in patients for whom there is a reasonable suspicion of valvular or structural heart disease	9	9	9	9	9	9	9	9	8	9	9	9	9	9	9	9	0.1	A	+
Mitral Valve Prolapse																				
18	Initial evaluation of patient with suspected mitral valve prolapse	8	9	9	9	9	9	9	9	5	8	4	8	8	8	9	9	0.9	A	+
19	Routine (yearly) re-evaluation of mitral valve prolapse in patients with no or mild mitral regurgitation and no change in clinical status	1	1	3	2	2	1	3	2	2	2	1	1	1	2	2	2	0.5	I	+
Native Valvular Stenosis																				
20	Initial evaluation of known or suspected native valvular stenosis	9	9	9	9	9	9	9	9	8	9	9	9	9	9	9	9	0.1	A	+
21	Routine (yearly) re-evaluation of an asymptomatic patient with mild native AS or mild-moderate native MS and no change in clinical status	2	3	3	2	3	3	3	2	2	3	1	1	1	3	2	2	0.7	I	+
22	Routine (yearly) evaluation of an asymptomatic patient with severe native valvular stenosis	8	7	7	6	7	8	8	8	5	7	6	1	9	7	9	7	1.2	A	+
23	Re-evaluation of a patient with native valvular stenosis who has had a change in clinical status	9	9	9	9	8	9	9	9	9	9	8	9	9	9	9	9	0.1	A	+
Native Valvular Regurgitation																				
24	Initial evaluation of known or suspected native valvular regurgitation	9	9	9	9	9	9	9	9	7	9	9	9	9	9	9	9	0.1	A	+
25	Routine (yearly) re-evaluation of native valvular regurgitation in an asymptomatic patient with mild regurgitation, no change in clinical status and normal LV size	1	1	2	1	2	1	2	4	2	2	1	1	1	2	2	2	0.6	I	+
26	Routine (yearly) re-evaluation of an asymptomatic patient with severe native valvular regurgitation with no change in clinical status	8	7	9	9	8	8	7	7	7	7	7	9	8	8	9	8	0.7	A	+
27	Re-evaluation of native valvular regurgitation in patients with a change in clinical status	9	9	9	9	9	9	9	9	9	9	8	9	9	9	9	9	0.1	A	+

Indication		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree	
Prosthetic Valve																					
28	Initial evaluation of prosthetic valve for establishment of baseline after placement	8	9	9	9	8	9	8	9	7	8	9	9	9	8	9	9	0.5	A	+	
29	Routine (yearly) evaluation of a patient with a prosthetic valve in whom there is no suspicion of valvular dysfunction and no change in clinical status	2	3	4	3	2	3	3	3	1	3	1	1	2	3	3	3	0.7	I	+	
30	Re-evaluation of patients with prosthetic valve with suspected dysfunction or thrombosis OR a change in clinical status	9	9	9	9	8	9	9	9	9	9	8	9	9	9	9	9	0.1	A	+	
Infective Endocarditis (Native or Prosthetic Valves)																					
31	Initial evaluation of suspected infective endocarditis (native and/or prosthetic valve) with positive blood cultures or a new murmur	9	9	9	9	9	9	9	9	9	9	8	9	9	9	9	9	0.1	A	+	
32	Evaluation of native and/or prosthetic valves in patients with transient fever but without evidence of bacteremia or new murmur	2	1	3	2	2	2	4	2	5	5	1	1	3	4	2	2	1.0	I	+	
33	Re-evaluation of infective endocarditis in patients with any of the following: virulent organism, severe hemodynamic lesion, aortic involvement, persistent bacteremia, a change in clinical status or symptomatic deterioration	9	9	9	9	8	9	9	9	8	9	8	9	9	9	9	9	0.2	A	+	
Table 4. Evaluation of Intra and Extra Cardiac Structures and Chambers																					
34	Evaluation for cardiovascular source of embolic event (PFO/ASD, thrombus, neoplasm)	8	9	9	9	9	9	8	8	7	8	7	8	8	9	9	8	0.6	A	+	
35	Evaluation of cardiac mass (suspected tumor or thrombus)	8	9	9	9	8	9	9	9	9	9	7	9	9	9	9	9	0.3	A	+	
36	Evaluation of pericardial conditions including but not limited to: pericardial mass, effusion, constrictive pericarditis, effusive-constrictive conditions, patients post-cardiac surgery, or suspected pericardial tamponade	9	9	9	9	8	9	9	9	9	9	9	9	9	9	9	9	0.1	A	+	
Table 5. Evaluation of Aortic Disease																					
37	Known or suspected Marfan disease for evaluation of proximal aortic root and/or mitral valve	9	9	9	9	8	9	9	9	9	9	7	9	9	9	9	9	0.2	A	+	

Indication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree
Table 6. Evaluation of Hypertension, Heart Failure, or Cardiomyopathy																			
Hypertension																			
38	Initial evaluation of suspected hypertensive heart disease	8	9	8	7	7	8	7	8	8	8	7	1	8	8	8	8	A	+
39	Routine evaluation of patients with systemic hypertension without suspected hypertensive heart disease	2	3	5	3	2	3	4	3	2	2	1	1	1	6	3	3	I	+
40	Re-evaluation of a patient with known hypertensive heart disease without a change in clinical status	2	7	3	3	3	3	3	3	2	3	1	1	2	2	2	3	I	+
Heart Failure																			
41	Initial evaluation of known or suspected heart failure (systolic or diastolic)	9	9	9	9	8	9	9	9	9	9	9	9	9	9	9	9	A	+
42	Routine (yearly) re-evaluation of patients with heart failure (systolic or diastolic) in whom there is no change in clinical status	2	5	5	3	3	3	3	6	4	3	1	1	4	3	2	3	I	
43	Re-evaluation of known heart failure (systolic or diastolic) to guide therapy in a patient with a change in clinical status	8	9	9	9	7	9	8	9	8	9	6	9	9	9	9	9	A	+
Pacing Device Evaluation																			
44	Evaluation for dyssynchrony in a patient being considered for CRT	8	9	7	7	5	6	8	9	8	8	5	8	9	8	9	8	A	+
45	Patient with known implanted pacing device with symptoms possibly due to suboptimal pacing device settings to re-evaluate for dyssynchrony and/or revision of pacing device settings	8	9	8	7	7	8	7	9	7	8	6	7	9	8	9	8	A	+
Hypertrophic Cardiomyopathy																			
46	Initial evaluation of known or suspected hypertrophic cardiomyopathy	9	9	9	9	8	9	9	9	9	9	9	9	9	9	9	9	A	+
47	Routine (yearly) evaluation of hypertrophic cardiomyopathy in a patient with no change in clinical status	2	3	4	3	3	6	3	4	3	4	1	1	5	3	3	3	I	
48	Re-evaluation of known hypertrophic cardiomyopathy in a patient with a change in clinical status to guide or evaluate therapy	9	9	9	9	8	9	9	9	8	9	7	9	9	9	9	9	A	+
Cardiomyopathy (Other)																			
49	Evaluation of suspected restrictive, infiltrative, or genetic cardiomyopathy	9	9	9	9	7	9	9	9	9	9	7	9	9	9	9	9	A	+

Indication		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree	
50	Screening study for structure and function in first degree relatives of patients with inherited cardiomyopathy	8	9	8	8	6	8	8	9	8	8	7	9	8	8	9	8	0.5	A	+	
Therapy with Cardiotoxic Agents																					
51	Baseline and serial re-evaluations in patients undergoing therapy with cardiotoxic agents	9	9	8	8	7	9	8	9	8	8	5	9	9	8	9	8	0.7	A	+	
Table 7. Use of Transesophageal Echocardiogram (TEE) as the Initial test																					
Use of TEE as Initial Test – Common Uses																					
52	Evaluation of suspected acute aortic pathology including dissection/transection	9	9	9	9	8	9	7	9	8	8	9	9	9	8	9	9	0.4	A	+	
53	Guidance during percutaneous non-coronary cardiac interventions including but not limited to septal ablation in patients with hypertrophic cardiomyopathy, mitral valvuloplasty, PFO/ASD closure, radiofrequency ablation	9	9	9	9	8	8	8	9	8	8	8	9	9	8	9	9	0.5	A	+	
54	To determine mechanism of regurgitation and determine suitability of valve repair	9	9	9	9	8	9	8	9	8	8	7	9	9	8	9	9	0.5	A	+	
55	To diagnose/manage endocarditis with a moderate or high pre-test probability (e.g., bacteremia, especially staph bacteremia or fungemia)	8	9	9	9	9	9	8	9	8	8	7	9	9	8	9	9	0.5	A	+	
56	Persistent fever in patient with intra-cardiac device	9	9	9	9	7	8	8	9	9	8	7	9	9	8	9	9	0.5	A	+	
Use of TEE as the Initial Test* - Common Uses - Atrial Fibrillation/Flutter																					
57	Evaluation of patient with atrial fibrillation/flutter to facilitate clinical decision making with regards to anticoagulation and/or cardioversion and/or radiofrequency ablation	9	9	9	9	9	9	9	9	8	9	8	9	9	9	9	9	0.1	A	+	
58	Evaluation of patient with atrial fibrillation/flutter for left atrial thrombus or spontaneous contrast when a decision has been made to anticoagulate and not to perform cardioversion	1	3	3	9	3	3	3	3	3	3	1	1	1	3	1	3	1.1	I	+	

Indication		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree
Use of TEE – Embolic Event																				
59	Evaluation for cardiovascular source of embolic event in a patient who has a normal transthoracic echo and normal electrocardiogram and no history of atrial fibrillation/flutter	6	8	6	6	6	7	6	5	3	6	5	5	5	6	9	6	0.9	U	+

- Median is the middlemost rating
- MADM is the median absolute deviation from the mean
- "I" is inappropriate; "U" is uncertain, and "A" is appropriate; "+" is agreement and "-" is disagreement. Level of agreement was based on BIOMED rule for a panel of 14-16 (i.e., agreement is where 4 or less panelists rate outside the 3-point region containing the median indicates agreement and disagreement is where the number of panelists rating in each extreme region is at least 5).

Appendix B.

Appropriateness Criteria for Echocardiography Related Guideline Recommendations and References

Assumptions for echocardiography:

1. All indications are assumed to be for adult patients (18 years of age or older).
2. The test is performed by a qualified individual in a facility that is proficient in the imaging technique.

Additional assumptions for TTE/TEE indications:

1. Panel members are to assume that standard TTE examination and report will include:
 - a. Use of a standard set of 2D views evaluating the cardiac structures^{1, 2}
 - b. Use of 2D/M-mode imaging, color flow Doppler, and spectral Doppler are generally considered to be important elements of a comprehensive TTE or TEE study.^{3, 4, 5} In evaluating the appropriate indications it is assumed that these elements would be part of the performance of the TTE or TEE examination.

¹ Shanewise JS, Cheung AT, Aronson S, Stewart WJ, Weiss RL, Mark JB, Savage RM, Sears-Rogan P, Mathew JP, Quinones MA, Cahalan MK, Savino JS. ASE/SCA guidelines for performing a comprehensive intraoperative multiplane transesophageal echocardiography examination: recommendations of the American Society of Echocardiography Council for Intraoperative Echocardiography and the Society of Cardiovascular Anesthesiologists Task Force for Certification in Perioperative Transesophageal Echocardiography. *Anesth Analg.* 1999 Oct;89(4):870-84.

² Henry WL, DeMaria A, Gramiak R, DL King, JA Kisslo, RL Popp, DJ Sahn, NB, Schiller, A Tajik, LE Teichholz and AE Weyman. Report of the American Society of Echocardiography committee on nomenclature and standards in two-dimensional echocardiography. *Circulation* 1980;62:212-5.

³ Cheitlin, MD, Armstrong, WF, Aurigemma, GP, Beller, GA, Bierman, FZ, Davis, JL, Douglas, PS, Faxon, DP, Gillam, LD, Kimball, TR, Kussmaul, WG, Pearlman, AS, Philbrick, JT, Rakowski, H, Thys, DM, Antman, EM, Smith, Jr, SC, Alpert, JS, Gregoratos, G, Anderson, JL, Hiratzka, LF, Faxon, DP, Hunt, SA, Fuster, V, Jacobs, AK, Gibbons, RJ, and Russell, RO. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography: summary article: a report of the American college of cardiology/American heart association task force on practice guidelines (ACC/AHA/ASE committee to update the 1997 guidelines for the clinical application of echocardiography). *J. Am. Coll. Cardiol.*, Sep 2003; 42: 954 - 970.

⁴ Waggoner AD, Ehler D, Adams D, Moos S, Rosenbloom J, Gresser C, Perez JE, Douglas PS. Guidelines for the cardiac sonographer in the performance of contrast echocardiography: Recommendations of the American Society of Echocardiography Council on Cardiac Sonography. *J Am Soc Echocardiogr* 2001;14:417-20.

- c. Use of contrast is indicated and will be performed when more than two contiguous segments of the left ventricular endocardial border are not visualized.⁶
2. In general, it is assumed that TEE is appropriately used as an adjunct or subsequent test to TTE when suboptimal TTE images preclude obtaining a diagnostic study. The indications for which TEE may reasonably be the test of first choice include, but are not limited to the indications presented in the TEE table.
3. It is reasonable to use TEE as a first test when:
 - a. It is likely that suboptimal images will preclude obtaining a diagnostic TTE study based on patient characteristics alone (patient is intubated, recent post op, intra-procedural study, severe chest wall abnormalities and or COPD etc); or when
 - b. Visualization of certain structures seen best by TEE is necessary to achieve the goals of the imaging test including but not limited to the mitral valve, atria, great vessels and/or prosthetic valves.
4. Intraoperative echocardiography is an important use of this imaging modality. However, we explicitly did not consider indications for its use as this is outside the scope of this document.
5. The range of potential indications for TTE/TEE is quite large, particularly in comparison with other cardiovascular imaging tests. Thus the indications are, at times, purposefully broad to cover an array of cardiovascular signs and symptoms as well the ordering physician's best judgment as to the presence of cardiovascular abnormalities.

⁵ Zoghbi, WA, Enriquez-Sarano, M, Foster, E, Grayburn, PA, Kraft, CD, Levine, RA, Nihoyannopoulos, P, Otto, CM, Quinones, MA, Rakowski, H, Stewart, WJ, Waggoner, A, and Weissman, NJ. Recommendations for Evaluation of the Severity of Native Valvular Regurgitation with Two-dimensional and Doppler Echocardiography. *J Am Soc Echocardiogr* 2003; 16:777-802.

⁶ Mulvagh SL, DeMaria AN, Feinstein SB, Burns PN, Kaul S, Miller JG, Monaghan M, Porter TR, Shaw LJ, Villanueva FS. Contrast echocardiography: current and future applications. *J Am Soc Echocardiogr*. 2000 Apr;13(4):331-42.

Table 1: General Evaluation of Structure and Function

Indication: Use of Transthoracic/Transesophageal Echocardiography		Guideline Recommendations
Suspected Cardiac Etiology - General		
<p>1.</p>	<p>Symptoms potentially due to suspected cardiac etiology, including but not limited to dyspnea, shortness of breath, lightheadedness, syncope, TIA, cerebrovascular events</p>	<p><i>Valvular Heart Disease (p. e11-e12)</i> 2.1.4. Echocardiography Class I Echocardiography is recommended for patients with heart murmurs and symptoms or signs of heart failure, myocardial ischemia/infarction, syncope, thromboembolism, infective endocarditis, or other clinical evidence of structural heart disease.</p> <p><i>Echocardiography (p. 37)</i> Recommendations for Echocardiography in Patients With Dyspnea, Edema, or Cardiomyopathy Class I Dyspnea with clinical signs of heart disease</p> <p><i>Echocardiography (p. 49)</i> Recommendations for Echocardiography in the Patient With Syncope Class I Syncope in a patient with clinically suspected heart disease.</p>
<p>2.</p>	<p>Prior testing that is concerning for heart disease (i.e. chest x-ray, baseline scout images for stress echocardiogram, electrocardiogram, elevation of serum BNP)</p>	<p>None</p>
Adult Congenital Heart Disease		
<p>3.</p>	<p>Assessment of known or suspected adult congenital heart disease including anomalies of great vessels, and cardiac chambers and valves or suspected intracardiac shunt (ASD, VSD, PDA) either in unoperated patient or following repair/operation</p>	<p><i>Echocardiography (p. 60)</i> Recommendations for Echocardiography in the Adult Patient With Congenital Heart Disease Class I Patients with clinically suspected congenital heart disease, as evidenced by signs and symptoms such as a murmur, cyanosis, or unexplained arterial desaturation, and an abnormal ECG or radiograph suggesting congenital heart disease.</p>

		<p><i>Echocardiography (p. 60)</i> Recommendations for Echocardiography in the Adult Patient With Congenital Heart Disease Class III Multiple repeat echocardiography in patients with repaired patent ductus arteriosus, atrial septal defect, ventricular septal defect, coarctation of the aorta,</p>
4.	Routine (yearly) evaluation of asymptomatic patients with corrected ASD, VSD or PDA more than one year after successful correction	<p><i>Echocardiography (p. 58-60)</i> Recommendations for Echocardiography in the Adult Patient With Congenital Heart Disease Class III Multiple repeat echocardiography in patients with repaired patent ductus arteriosus, atrial septal defect, ventricular septal defect, coarctation of the aorta, or bicuspid aortic valve without change in clinical condition.</p>
Arrhythmias		
5.	Patients who have isolated APC or PVC without other evidence of heart disease	<p><i>Echocardiography (p. 47)</i> Recommendations for Echocardiography in Patients With Arrhythmias and Palpitations Class I Arrhythmias with clinical suspicion of structural heart disease.</p> <p>Class IIa Arrhythmia requiring treatment.</p> <p>Class IIb Arrhythmias commonly associated with, but without clinical evidence of, heart disease.</p> <p><i>Stable Angina (p. 33)</i> Recommendations for Measurement of Rest LV Function by Echocardiography or Radionuclide Angiography in Patients With Chronic Stable Angina Class I Echocardiography or RNA in patients with complex ventricular arrhythmias to assess LV function.</p>

6.	Patients who have sustained or non sustained SVT or VT	<p><i>Echocardiography (p. 47)</i> Recommendations for Echocardiography in Patients With Arrhythmias and Palpitations Class I Arrhythmias with clinical suspicion of structural heart disease.</p> <p>Class IIa Arrhythmia requiring treatment.</p> <p>Class IIb Arrhythmias commonly associated with, but without clinical evidence of, heart disease.</p> <p><i>Stable Angina (p. 33)</i> Recommendations for Measurement of Rest LV Function by Echocardiography or Radionuclide Angiography in Patients With Chronic Stable Angina Class I Echocardiography or RNA in patients with complex ventricular arrhythmias to assess LV function.</p>
LV Function Evaluation		
7.	Evaluation of LV function with prior ventricular function evaluation within the past year with normal function (such as prior echocardiogram, LV gram, SPECT, cardiac MRI) in patients in whom there has been no change in clinical status	None
8.	Initial evaluation of LV function following acute myocardial infarction	<p><i>STEMI (p. e135)</i> 7.11.1.2. Role of Echocardiography Class I Echocardiography should be used in patients with STEMI not undergoing LV angiography to assess baseline LV function, especially if the patient is hemodynamically unstable.</p>
9.	Re-evaluation of LV function following myocardial infarction during recovery phase when results will guide therapy	<p><i>Echocardiography (p. 19)</i> Recommendations for Echocardiography in Risk Assessment, Prognosis, and Assessment of Therapy in Acute Myocardial Ischemic Syndromes Class I In-hospital assessment of ventricular function when the results are used to guide therapy.</p>

		<p>CABG (p. e242) RECENT ANTERIOR MI, LV MURAL THROMBUS, AND STROKE RISK. Class IIb In patients having a recent anterior MI, preoperative screening with echocardiography may be considered to detect LV thrombus, because the technical approach and timing of surgery may be altered.</p>
Pulmonary Hypertension		
10.	Evaluation of known or suspected pulmonary hypertension including evaluation of right ventricular function and estimated pulmonary artery pressure	<p>Echocardiography (p. 42) Recommendations for Echocardiography in Pulmonary and Pulmonary Vascular Disease Class I Suspected pulmonary hypertension.</p> <p>Class IIa Measurement of exercise pulmonary artery pressure.</p>

Table 1 References:

Dent JM. Role of echocardiography in the evaluation and management of atrial fibrillation. *Cardiol Clin.* 1996 Nov;14(4):543-53. Review. PMID: 8950056 [PubMed - indexed for MEDLINE]

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Poortmans G, Schupfer G, Roosens C, Poelaert J. Transesophageal echocardiographic evaluation of left ventricular function. *J Cardiothorac Vasc Anesth.* 2000 Oct;14(5):588-98. Review. PMID: 11052447 [PubMed - indexed for MEDLINE]

Schiller NB, Maurer G et al. "Transesophageal echocardiography." *J Am Soc Echocardiogr.* 1989 Sep-Oct;2(5):354-7.

Seward JB. Biplane and multiplane transesophageal echocardiography: evaluation of congenital heart disease. *Am J Card Imaging.* 1995 Apr;9(2):129-36. Review. PMID: 7795377 [PubMed - indexed for MEDLINE]

Skiles JA, Griffin BP. Transesophageal echocardiographic (TEE) evaluation of ventricular function. *Cardiol Clin.* 2000 Nov;18(4):681-97, vii. Review. PMID: 11236160 [PubMed - indexed for MEDLINE]

Table 2: Cardiovascular Evaluation in an Acute Setting

Indication: Use of Transthoracic/Transesophageal Echocardiography		Guideline Recommendations
Hypotension or Hemodynamic Instability		
11.	Evaluation of hypotension or hemodynamic instability of uncertain or suspected cardiac etiology	<p><i>Echocardiography (p. 11)</i> Recommendations for Echocardiography in Infective Endocarditis: Native Valves Class I Detection and characterization of valvular lesions, their hemodynamic severity, and/or ventricular compensation.</p> <p><i>Echocardiography (p. 15)</i> Recommendations for Echocardiography in Patients With Chest Pain Class I Evaluation of patients with chest pain and hemodynamic instability unresponsive to simple therapeutic measures (see section XIII).</p> <p><i>Echocardiography (p. 57)</i> Recommendations for Echocardiography in the Critically Ill Class I The hemodynamically unstable patient.</p>
Myocardial Ischemia/Infarction		
12.	Evaluation of acute chest pain with suspected myocardial ischemia in patients with nondiagnostic laboratory markers and ECG and in whom a resting echocardiogram can be performed during pain	<p><i>Echocardiography (p. 15)</i> Recommendations for Echocardiography in Patients With Chest Pain Class I Evaluation of chest pain in patients with suspected acute myocardial ischemia, when baseline ECG and other laboratory markers are nondiagnostic and when study can be obtained during pain or within minutes after its abatement (see section IV).</p> <p><i>Echocardiography (p. 19-22)</i> Recommendations for Echocardiography in the Diagnosis of Acute Myocardial Ischemic Syndromes Class I Diagnosis of suspected acute ischemia or infarction not evident by standard means.</p> <p><i>Stable Angina (p. 21)</i> Recommendations for Echocardiography for Diagnosis of Cause of Chest Pain in Patients With Suspected Chronic Stable Angina Pectoris Class I</p>

		<p>Evaluation of extent (severity) of ischemia (e.g., LV segmental wall-motion abnormality) when the echocardiogram can be obtained during pain or within 30 min after its abatement.</p> <p>STEMI (p. e34) 6.2.6. Imaging Class I Imaging studies such as a high-quality portable chest X-ray, transthoracic and/or transesophageal echocardiography, and a contrast chest CT scan or magnetic resonance imaging scan should be used for differentiating STEMI from aortic dissection in patients for whom this distinction is initially unclear.</p> <p>Class IIa Portable echocardiography is reasonable to clarify the diagnosis of STEMI and allow risk stratification of patients with chest pain who present to the ED, especially if the diagnosis of STEMI is confounded by LBBB or pacing or if there is suspicion of posterior STEMI with anterior ST depressions.</p>
13.	<p>Evaluation of suspected complication of myocardial ischemia/infarction, including but not limited to acute mitral regurgitation, hypoxemia, abnormal chest x-ray, VSD, free wall rupture/tamponade, shock, right ventricular involvement, heart failure, or thrombus</p>	<p>Echocardiography (p. 19-22) Recommendations for Echocardiography in the Diagnosis of Acute Myocardial Ischemic Syndromes Class I</p> <ul style="list-style-type: none"> • Evaluation of patients with inferior myocardial infarction and clinical evidence suggesting possible RV infarction. • Assessment of mechanical complications and mural thrombus.* <p>*TEE is indicated when TTE studies are not diagnostic.</p> <p>Echocardiography (p. 38) Recommendations for Echocardiography in Pericardial Disease Class IIa</p> <ol style="list-style-type: none"> 1. Follow-up studies to detect early signs of tamponade in the presence of large or rapidly accumulating effusions. A goal-directed study may be appropriate. <p>STEMI (p. e95) 7.6.2. Hypotension Class I Echocardiography should be used to evaluate mechanical complications unless these are assessed by invasive measures.</p> <p>STEMI (p. e95) 7.6.3. Low-Output State</p>

		<p>Class I Left ventricular function and potential presence of a mechanical complication should be assessed by echocardiography if these have not been evaluated by invasive measures.</p> <p>STEMI (p. e98) 7.6.5. Cardiogenic Shock Class I Echocardiography should be used to evaluate mechanical complications unless these are assessed by invasive measures.</p> <p>STEMI (p. e135) 7.11.1.2. Role of Echocardiography Class I</p> <ul style="list-style-type: none"> Echocardiography should be used to evaluate patients with inferior STEMI, clinical instability, and clinical suspicion of RV infarction. (See the ACC/AHA/ASE 2003 Guideline Update for Clinical Application of Echocardiography (226).) Echocardiography should be used in patients with STEMI to evaluate suspected complications, including acute MR, cardiogenic shock, infarct expansion, VSD, intracardiac thrombus, and pericardial effusion.
Respiratory Failure		
14.	Evaluation of respiratory failure with suspected cardiac etiology	<p>Echocardiography (p. 57) Recommendations for Echocardiography in the Critically Ill Class I The hemodynamically unstable patient.</p>
Pulmonary Embolism		
15.	Initial evaluation of patient with suspected pulmonary embolism in order to establish diagnosis	None
16.	Evaluation of patient with known or suspected acute pulmonary embolism to guide therapy (i.e. thrombectomy and thrombolytics)	<p>Echocardiography (p. 42) Recommendations for Echocardiography in Pulmonary and Pulmonary Vascular Disease Class IIa Pulmonary emboli and suspected clots in the right atrium or ventricle or main pulmonary artery branches.*</p> <p>*TEE is indicated when TTE studies are not diagnostic.</p>

Table 2 References:

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Table 3: Evaluation of Valvular Function

Indication: Use of Transthoracic/Transesophageal Echocardiography		Guideline Recommendations
Murmur		
17.	Initial evaluation of murmur in patients for whom there is a reasonable suspicion of valvular or structural heart disease	<p><i>Echocardiography (p. 8)</i> Recommendations for Echocardiography in the Evaluation of Patients With a Heart Murmur Class I</p> <ul style="list-style-type: none"> • A patient with a murmur and cardiorespiratory symptoms. • An asymptomatic patient with a murmur in whom clinical features indicate at least a moderate probability that the murmur is reflective of structural heart disease. <p><i>Stable Angina (p. 21)</i> Recommendations for Echocardiography for Diagnosis of Cause of Chest Pain in Patients With Suspected Chronic Stable Angina Pectoris Class I Patients with systolic murmur suggestive of aortic stenosis or hypertrophic cardiomyopathy</p>

		<p>Valvular Heart Disease (p. e11-e12) 2.1.4. Echocardiography Class I Echocardiography is recommended for patients with heart murmurs and symptoms or signs of heart failure, myocardial ischemia/infarction, syncope, thromboembolism, infective endocarditis, or other clinical evidence of structural heart disease.</p> <p>Class III Echocardiography is not recommended for patients who have a grade 2 or softer midsystolic murmur identified as innocent or functional by an experienced observer.</p>
Mitral Valve Prolapse		
18.	Initial evaluation of patient with suspected mitral valve prolapse	<p>Echocardiography (p. 11) Recommendations for Echocardiography in Mitral Valve Prolapse Class I Diagnosis; assessment of hemodynamic severity, leaflet morphology, and/or ventricular compensation in patients with physical signs of MVP.</p> <p>Valvular Heart Disease (p. e56) 3.5.2. Evaluation and Management of the Asymptomatic Patient Class I Echocardiography is indicated for the diagnosis of MVP and assessment of MR, leaflet morphology, and ventricular compensation in asymptomatic patients with physical signs of MVP.</p>
19.	Routine (yearly) re-evaluation of mitral valve prolapse in patients with no or mild mitral regurgitation and no change in clinical status	<p>Echocardiography (p. 11) Recommendations for Echocardiography in Mitral Valve Prolapse Class III Routine repetition of echocardiography in patients with MVP with no or mild regurgitation and no changes in clinical signs or symptoms.</p> <p>Valvular Heart Disease (p. e56) 3.5.2. Evaluation and Management of the Asymptomatic Patient Class III Routine repetition of echocardiography is not indicated for the asymptomatic patient who has MVP and no MR or MVP and mild MR with no changes in clinical signs or symptoms.</p>

Native Valvular Stenosis

20.	Initial evaluation of known or suspected native valvular stenosis	<p>Echocardiography (p. 8) Recommendations for Echocardiography in Valvular Stenosis Class I Assessment of changes in hemodynamic severity and ventricular compensation in patients with known valvular stenosis during pregnancy.</p> <p>Valvular Heart Disease (p. e20-e21) 3.1.4.1. Echocardiography (Imaging, Spectral, and Color Doppler) in Aortic Stenosis Class I Echocardiography is recommended for the diagnosis and assessment of AS severity.</p> <p>Valvular Heart Disease (p. e42) 3.4.2. Indications for Echocardiography in Mitral Stenosis Class I Echocardiography should be performed in patients for the diagnosis of MS, assessment of hemodynamic severity (mean gradient, MV area, and pulmonary artery pressure), assessment of concomitant valvular lesions, and assessment of valve morphology (to determine suitability for percutaneous mitral balloon valvotomy).</p>
21.	Routine (yearly) re-evaluation of an asymptomatic patient with mild native AS or mild-moderate native MS and no change in clinical status	<p>Echocardiography (p. 8) Recommendations for Echocardiography in Valvular Stenosis Class IIb Re-evaluation of patients with mild to moderate aortic valvular stenosis with stable signs and symptoms.</p> <p>Class III</p> <ul style="list-style-type: none"> • Routine re-evaluation of asymptomatic adult patients with mild aortic stenosis having stable physical signs and normal LV size and function. • Routine re-evaluation of asymptomatic patients with mild to moderate mitral stenosis and stable physical signs.
22.	Routine (yearly) evaluation of an asymptomatic patient with severe native valvular stenosis	<p>Echocardiography (p. 8) Recommendations for Echocardiography in Valvular Stenosis Class I</p> <ul style="list-style-type: none"> • Re-evaluation of patients with known valvular stenosis with changing symptoms or signs.

		<ul style="list-style-type: none"> • Re-evaluation of asymptomatic patients with severe stenosis. <p>Valvular Heart Disease (p. e20-e21) 3.1.4.1. Echocardiography (Imaging, Spectral, and Color Doppler) in Aortic Stenosis Class I</p> <ul style="list-style-type: none"> • Echocardiography is recommended for re-evaluation of patients with known AS and changing symptoms or signs. • Echocardiography is recommended for the assessment of changes in hemodynamic severity and LV function in patients with known AS during pregnancy. • Transthoracic echocardiography is recommended for re-evaluation of asymptomatic patients: every year for severe AS; every 1 to 2 years for moderate AS; and every 3 to 5 years for mild AS. <p>Valvular Heart Disease (p. e42) 3.4.2. Indications for Echocardiography in Mitral Stenosis Class I</p> <p>Echocardiography should be performed for reevaluation in patients with known MS and changing symptoms or signs.</p> <p>Class IIa</p> <p>Echocardiography is reasonable in the re-evaluation of asymptomatic patients with MS and stable clinical findings to assess pulmonary artery pressure (for those with severe MS, every year; moderate MS, every 1 to 2 years; and mild MS, every 3 to 5 years).</p>
23.	Re-evaluation of a patient with native valvular stenosis who has had a change in clinical status	<p>Echocardiography (p. 8) Recommendations for Echocardiography in Valvular Stenosis Class I</p> <p>Re-evaluation of patients with known valvular stenosis with changing symptoms or signs.</p> <p>Valvular Heart Disease (p. e20-e21) 3.1.4.1. Echocardiography (Imaging, Spectral, and Color Doppler) in Aortic Stenosis Class I</p> <ul style="list-style-type: none"> ▪ Echocardiography is recommended for re-evaluation of patients with known AS and changing symptoms or signs. <i>(Level of Evidence: B)</i> ▪ Echocardiography is recommended for the assessment of changes in hemodynamic severity and LV function in patients with known AS during pregnancy. <i>(Level of Evidence: B)</i>

		<ul style="list-style-type: none"> Transthoracic echocardiography is recommended for re-evaluation of asymptomatic patients: every year for severe AS; every 1 to 2 years for moderate AS; and every 3 to 5 years for mild AS. (<i>Level of Evidence: B</i>) <p>Valvular Heart Disease (p. e42) 3.4.2. Indications for Echocardiography in Mitral Stenosis Class I Echocardiography should be performed for reevaluation in patients with known MS and changing symptoms or signs. (<i>Level of Evidence: B</i>)</p>
Native Valvular Regurgitation		
24.	Initial evaluation of known or suspected native valvular regurgitation	<p>Echocardiography (p. 9) Recommendations for Echocardiography in Native Valvular Regurgitation Class I</p> <ul style="list-style-type: none"> Diagnosis; assessment of hemodynamic severity. Initial assessment and re-evaluation (when indicated) of LV and RV size, function, and/or hemodynamics. Assessment of changes in hemodynamic severity and ventricular compensation in patients with known valvular regurgitation during pregnancy. Assessment of valvular morphology and regurgitation in patients with a history of anorectic drug use, or the use of any drug or agent known to be associated with valvular heart disease, who are symptomatic, have cardiac murmurs, or have a technically inadequate auscultatory examination. <p>Valvular Heart Disease (p. e60) Indications for Transthoracic Echocardiography Class I</p> <ul style="list-style-type: none"> Transthoracic echocardiography is indicated for baseline evaluation of LV size and function, RV and left atrial size, pulmonary artery pressure, and severity of MR (Table 4) in any patient suspected of having MR. Transthoracic echocardiography is indicated for delineation of the mechanism of MR.
25.	Routine (yearly) re-evaluation of native valvular regurgitation in an asymptomatic patient with mild regurgitation, no change in clinical status and normal LV size	<p>Echocardiography (p. 9) Recommendations for Echocardiography in Native Valvular Regurgitation Class IIb Re-evaluation of patients with mild to moderate mitral regurgitation without chamber dilation and without clinical symptoms.</p>

		<p>Class III Routine re-evaluation in asymptomatic patients with mild valvular regurgitation having stable physical signs and normal LV size and function.</p> <p>Valvular Heart Disease (p. e60) Indications for Transthoracic Echocardiography Class III Transthoracic echocardiography is not indicated for routine follow-up evaluation of asymptomatic patients with mild MR and normal LV size and systolic function.</p>
26.	Routine (yearly) re-evaluation of an asymptomatic patient with severe native valvular regurgitation with no change in clinical status	<p>Echocardiography (p. 9) Recommendations for Echocardiography in Native Valvular Regurgitation Class I</p> <ul style="list-style-type: none"> • Re-evaluation of asymptomatic patients with severe regurgitation. • Re-evaluation of patients with mild to moderate regurgitation with ventricular dilation without clinical symptoms. <p>Valvular Heart Disease (p. e60) Indications for Transthoracic Echocardiography Class I Transthoracic echocardiography is indicated for annual or semiannual surveillance of LV function (estimated by ejection fraction and end-systolic dimension) in asymptomatic patients with moderate to severe MR.</p>
27.	Re-evaluation of native valvular regurgitation in patients with a change in clinical status	None
Prosthetic Valve		
28.	Initial evaluation of prosthetic valve for establishment of baseline after placement	<p>Echocardiography (p. 13-14) Recommendations for Echocardiography in Interventions for Valvular Heart Disease and Prosthetic Valves Class I Postintervention baseline studies for valve function (early) and ventricular remodeling (late).</p> <p>Valvular Heart Disease (p. e116-e117) 9.3. Follow-Up Visits Class I For patients with prosthetic heart valves, a history, physical examination, and appropriate tests should be performed at the first postoperative outpatient</p>

		evaluation, 2 to 4 weeks after hospital discharge. This should include a transthoracic Doppler echocardiogram if a baseline echocardiogram was not obtained before hospital discharge.
29.	Routine (yearly) evaluation of a patient with a prosthetic valve in whom there is no suspicion of valvular dysfunction and no change in clinical status	<p>Echocardiography (p. 13-14) Recommendations for Echocardiography in Interventions for Valvular Heart Disease and Prosthetic Valves Class III Routine re-evaluation of patients with valve replacements without suspicion of valvular dysfunction and with unchanged clinical signs and symptoms.</p> <p>Valvular Heart Disease (p. e116-e117) 9.3. Follow-Up Visits Class IIb Patients with bioprosthetic valves may be considered for annual echocardiograms after the first 5 years in the absence of a change in clinical status.</p> <p>Class III Routine annual echocardiograms are not indicated in the absence of a change in clinical status in patients with mechanical heart valves or during the first 5 years after valve replacement with a bioprosthetic valve.</p>
30.	Re-evaluation of patients with prosthetic valve with suspected dysfunction or thrombosis OR a change in clinical status	<p>Echocardiography (p. 13-14) Recommendations for Echocardiography in Interventions for Valvular Heart Disease and Prosthetic Valves Class I Re-evaluation of patients with valve replacement with changing clinical signs and symptoms; suspected prosthetic dysfunction (stenosis, regurgitation) or thrombosis.*</p> <p>Valvular Heart Disease (p. e116-e117) 9.3. Follow-Up Visits Class I For patients with prosthetic heart valves, routine follow-up visits should be conducted annually, with earlier re-evaluations (with echocardiography) if there is a change in clinical status.</p>

Infective Endocarditis (Native or Prosthetic Valves)

31.	Initial evaluation of suspected infective endocarditis (native and/or prosthetic valve) with positive blood cultures or a new murmur	<p><i>Echocardiography (p. 11)</i> Recommendations for Echocardiography in Infective Endocarditis: Native Valves Class I</p> <ul style="list-style-type: none"> • Detection and characterization of valvular lesions, their hemodynamic severity, and/or ventricular compensation.* • Detection of vegetations and characterizations of lesions in patients with congenital heart disease suspected of having infective endocarditis. <p>*TEE may frequently provide incremental value in addition to information obtained by TTE. The role of TEE in first-line examination awaits further study.</p> <p><i>Valvular Heart Disease (p. e77-e78)</i> Transthoracic Echocardiography in Endocarditis Class I Transthoracic echocardiography to detect valvular vegetations with or without positive blood cultures is recommended for the diagnosis of infective endocarditis.</p>
32.	Evaluation of native and/or prosthetic valves in patients with transient fever but without evidence of bacteremia or new murmur	<p><i>Echocardiography (p. 11)</i> Recommendations for Echocardiography in Infective Endocarditis: Native Valves Class III Evaluation of transient fever without evidence of bacteremia or new murmur.</p>
33.	Re-evaluation of infective endocarditis in patients with any of the following: virulent organism, severe hemodynamic lesion, aortic involvement, persistent bacteremia, a change in clinical status or symptomatic deterioration	<p><i>Echocardiography (p. 11)</i> Recommendations for Echocardiography in Infective Endocarditis: Native Valves Class I</p> <ul style="list-style-type: none"> • Re-evaluation studies in complex endocarditis (eg, virulent organism, severe hemodynamic lesion, aortic valve involvement, persistent fever or bacteremia, clinical change, or symptomatic deterioration). <p>Class IIa Evaluation of persistent nonstaphylococcus bacteremia without a known source.*</p> <p>*TEE may frequently provide incremental value in addition to information obtained by TTE. The role of TEE in first-line examination awaits further study.</p>

		<p>Valvular Heart Disease (p. e77-e78) 4.4.1. Transthoracic Echocardiography in Endocarditis Class I Transthoracic echocardiography is recommended for reassessment of high-risk patients (e.g., those with a virulent organism, clinical deterioration, persistent or recurrent fever, new murmur, or persistent bacteremia).</p>
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Table 4: Evaluation of Intra and Extra Cardiac Structures and Chambers

Indication: Use of Transthoracic/Transesophageal Echocardiography		Guideline Recommendations
34.	Evaluation for cardiovascular source of embolic event (PFO/ASD, thrombus, neoplasm)	Echocardiography (p. 45) Recommendations for Echocardiography in Patients With Neurological Events or Other Vascular Occlusive Events Class IIa Patients with suspicion of embolic disease and with cerebrovascular disease of questionable significance.
35.	Evaluation of cardiac mass (suspected tumor or thrombus)	Echocardiography (p. 40) Recommendations for Echocardiography in Patients With Cardiac Masses and Tumors Class I Evaluation of patients with clinical syndromes and events that suggest an underlying cardiac mass.
36.	Evaluation of pericardial conditions including but not limited to: pericardial mass, effusion, constrictive pericarditis, effusive-constrictive conditions, patients post-cardiac surgery, or suspected pericardial tamponade	Echocardiography (p. 38) Recommendations for Echocardiography in Pericardial Disease Class I <ul style="list-style-type: none"> • Patients with suspected pericardial disease, including effusion, constriction, or effusive-constrictive process. • Patients with suspected bleeding in the pericardial space (eg, trauma, perforation).

Table 4 References:

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Table 5: Evaluation of Aortic Disease

Indication: Use of Transthoracic/Transesophageal Echocardiography		Guideline Recommendations
37.	Known or suspected Marfan disease for evaluation of proximal aortic root and/or mitral valve	<p>Echocardiography (p. 41) Recommendations for Echocardiography in Suspected Thoracic Aortic Disease</p> <p>Class I</p> <ul style="list-style-type: none"> • Aortic rupture. • Aortic root dilation in Marfan syndrome or other connective tissue syndromes.* <p>*TTE should be the first choice in these situations, and TEE should only be used if the examination is incomplete or additional information is needed. Note: TEE is the technique that is indicated in examination of the entire aorta, especially in emergency situations.</p>

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Table 6. Evaluation of Hypertensive Heart Disease, Heart Failure, or Cardiomyopathy

Indication: Use of Transthoracic/Transesophageal Echocardiography		Guideline Recommendations
Hypertension		
38.	Initial evaluation of suspected hypertensive heart disease	Echocardiography (p. 43) Recommendations for Echocardiography in Hypertension Class I When assessment of resting LV function, hypertrophy, or concentric remodeling is important in clinical decision making (see LV function).
39.	Routine evaluation of patients with systemic hypertension without suspected hypertensive heart disease	Echocardiography (p. 43) Recommendations for Echocardiography in Hypertension Class III Re-evaluation in asymptomatic patients to assess LV function.
40.	Re-evaluation of a patient with known hypertensive heart disease without a change in clinical status	Echocardiography (p. 43) Recommendations for Echocardiography in Hypertension Class III <ul style="list-style-type: none"> • Re-evaluation to guide antihypertensive therapy based on LV mass regression. • Re-evaluation in asymptomatic patients to assess LV function.
Heart Failure		
41.	Initial evaluation of known or suspected heart failure (systolic or diastolic)	Echocardiography (p. 37) Recommendations for Echocardiography in Patients With Dyspnea, Edema, or Cardiomyopathy Class I Assessment of LV size and function in patients with suspected cardiomyopathy or clinical diagnosis of heart failure.* *TEE is indicated when TTE studies are not diagnostic. Heart Failure (p. e8 – e9) Recommendations for the Initial Clinical Assessment of Patients Presenting With HF

		<p>Class I Two-dimensional echocardiography with Doppler should be performed during initial evaluation of patients presenting with HF to assess LVEF, LV size, wall thickness, and valve function. Radionuclide ventriculography can be performed to assess LVEF and volumes.</p>
42.	Routine (yearly) re-evaluation of patients with heart failure (systolic or diastolic) in whom there is no change in clinical status	<p>Echocardiography (p. 37) Recommendations for Echocardiography in Patients With Dyspnea, Edema, or Cardiomyopathy Class III Routine re-evaluation in clinically stable patients in whom no change in management is contemplated and for whom the results would not change management</p>
43.	Re-evaluation of known heart failure (systolic or diastolic) to guide therapy in a patient with a change in clinical status	<p>Echocardiography (p. 37) Recommendations for Echocardiography in Patients With Dyspnea, Edema, or Cardiomyopathy Class I Re-evaluation of LV function in patients with established cardiomyopathy when there has been a documented change in clinical status or to guide medical therapy.</p> <p>Heart Failure (page e9-e10) Recommendations for Serial Clinical Assessment of Patients Presenting With HF Class IIa Repeat measurement of EF and the severity of structural remodeling can provide useful information in patients with HF who have had a change in clinical status or who have experienced or recovered from a clinical event or received treatment that might have had a significant effect on cardiac function.</p>
Pacing Device Evaluation		
44.	Evaluation for dyssynchrony in a patient being considered for CRT	None
45.	Patient with known implanted pacing device with symptoms possibly due to suboptimal pacing device settings to re-evaluate for dyssynchrony and/or revision of pacing device settings	None
Hypertrophic Cardiomyopathy		
46.	Initial evaluation of known or suspected hypertrophic cardiomyopathy	<p>Echocardiography (p. 37) Recommendations for Echocardiography in Patients With Dyspnea, Edema, or Cardiomyopathy</p>

		<p>Class I</p> <ul style="list-style-type: none"> • Assessment of LV size and function in patients with suspected cardiomyopathy or clinical diagnosis of heart failure.* • Suspicion of hypertrophic cardiomyopathy based on abnormal physical examination, ECG, or family history. <p>*TEE is indicated when TTE studies are not diagnostic.</p>
47.	Routine (yearly) evaluation of hypertrophic cardiomyopathy in a patient with no change in clinical status	<p><i>Echocardiography (p. 37)</i> Recommendations for Echocardiography in Patients With Dyspnea, Edema, or Cardiomyopathy Class IIb Re-evaluation of patients with established cardiomyopathy when there is no change in clinical status but where the results might change management.</p>
48.	Re-evaluation of known hypertrophic cardiomyopathy in a patient with a change in clinical status to guide or evaluate therapy	<p><i>Echocardiography (p. 37)</i> Recommendations for Echocardiography in Patients With Dyspnea, Edema, or Cardiomyopathy Class I</p> <ul style="list-style-type: none"> • Re-evaluation of LV function in patients with established cardiomyopathy when there has been a documented change in clinical status or to guide medical therapy.
Cardiomyopathy (Other)		
49.	Evaluation of suspected restrictive, infiltrative, or genetic cardiomyopathy	<p><i>Echocardiography (p. 37)</i> Recommendations for Echocardiography in Patients With Dyspnea, Edema, or Cardiomyopathy Class I</p> <ul style="list-style-type: none"> • Assessment of LV size and function in patients with suspected cardiomyopathy or clinical diagnosis of heart failure.* • Suspicion of hypertrophic cardiomyopathy based on abnormal physical examination, ECG, or family history. • <p>*TEE is indicated when TTE studies are not diagnostic.</p>
50.	Screening study for structure and function in first degree relatives of patients with inherited cardiomyopathy	<p><i>Echocardiography (p. 51)</i> Recommendations for Echocardiography to Screen for the Presence of Cardiovascular Disease Class I</p> <ul style="list-style-type: none"> • Patients with a family history of genetically transmitted cardiovascular disease. • First-degree relatives (parents, siblings, children) of patients with unexplained dilated cardiomyopathy in whom no etiology has been identified.

Therapy with Cardiotoxic Agents		
51.	Baseline and serial re-evaluations in patients undergoing therapy with cardiotoxic agents	<p><i>Echocardiography (p. 34)</i> Recommendations for Echocardiography in Patients With Dyspnea, Edema, or Cardiomyopathy Class I Patients exposed to cardiotoxic agents, to determine the advisability of additional or increased dosages.</p> <p><i>Echocardiography (p. 51)</i> Recommendations for Echocardiography to Screen for the Presence of Cardiovascular Disease Class I Baseline and re-evaluations of patients undergoing chemotherapy with cardiotoxic agents.</p> <p><i>Heart Failure (p. e15 - e16)</i> 4.1. Patients at High Risk for Developing HF Class I Healthcare providers should perform a noninvasive evaluation of LV function (i.e., LVEF) in patients with a strong family history of cardiomyopathy or in those receiving cardiotoxic interventions.</p>

Table 6 References:

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Table 7. Use of Transesophageal Echocardiogram (TEE)

Indication: Use of Transthoracic/Transesophageal Echocardiography		Guideline Recommendations
Use of TEE as Initial Test – Common Uses		
52.	Evaluation of suspected acute aortic pathology including dissection/transsection	<p>Echocardiography (p. 15) Recommendations for Echocardiography in Patients With Chest Pain Class I Evaluation of chest pain in patients with suspected aortic dissection (see section VIII).</p> <p>Echocardiography (p. 41) Recommendations for Echocardiography in Suspected Thoracic Aortic Disease Class I Aortic intramural hematoma.</p> <p>Echocardiography (p. 57) Recommendations for Echocardiography in the Critically Ill Class I Suspected aortic dissection (TEE).</p> <p>STEMI (p. e34) 6.2.6. Imaging Class I Imaging studies such as a high-quality portable chest X-ray, transthoracic and/or transesophageal echocardiography, and a contrast chest CT scan or magnetic resonance imaging scan should be used for differentiating STEMI from aortic dissection in patients for whom this distinction is initially unclear.</p>

53.	Guidance during percutaneous non-coronary cardiac interventions including but not limited to septal ablation in patients with hypertrophic cardiomyopathy, mitral valvuloplasty, PFO/ASD closure, radiofrequency ablation	<p><i>Echocardiography (p. 13-14)</i> Recommendations for Echocardiography in Interventions for Valvular Heart Disease and Prosthetic Valves Class I Use of echocardiography (especially TEE) in guiding the performance of interventional techniques and surgery (e.g., balloon valvotomy and valve repair) for valvular disease.</p> <p><i>Echocardiography (p. 47)</i> Recommendations for Echocardiography in Patients With Arrhythmias and Palpitations Class IIa TEE or intracardiac ultrasound guidance of radiofrequency ablative procedures.</p> <p><i>Echocardiography (p. 58-60)</i> Recommendations for Echocardiography in the Adult Patient With Congenital Heart Disease Class I To direct interventional catheter valvotomy, radiofrequency ablation, and interventions in the presence of complex cardiac anatomy.</p>
54.	To determine mechanism of regurgitation and determine suitability of valve repair	<p><i>Valvular Heart Disease (p. e61)</i> 3.6.3.4. Indications for Transesophageal Echocardiography (See also Section 8.1.4.) Class I Transesophageal echocardiography is indicated for evaluation of MR patients in whom transthoracic echocardiography provides nondiagnostic information regarding severity of MR, mechanism of MR, and/or status of LV function.</p> <p>Class IIa Preoperative transesophageal echocardiography is reasonable in asymptomatic patients with severe MR who are considered for surgery to assess feasibility of repair.</p>
55.	To diagnose/manage endocarditis with a moderate or high pre-test probability (e.g., bacteremia, especially staph bacteremia or fungemia)	<p><i>Echocardiography (p. 11)</i> Recommendations for Echocardiography in Infective Endocarditis: Native Valves Class I</p> <ul style="list-style-type: none"> ▪ Evaluation of patients with high clinical suspicion of culture-negative endocarditis.* ▪ If TTE is equivocal, TEE evaluation of bacteremia, especially staphylococcus bacteremia and fungemia without a known source. <p>Class IIa Evaluation of persistent nonstaphylococcus bacteremia without a known source.*</p>

		<p>*TEE may frequently provide incremental value in addition to information obtained by TTE. The role of TEE in first-line examination awaits further study.</p> <p>Valvular Heart Disease (p. e78-e80) 4.4.2. Transesophageal Echocardiography in Endocarditis Class I</p> <ul style="list-style-type: none"> ▪ Transesophageal echocardiography is recommended to assess the severity of valvular lesions in symptomatic patients with infective endocarditis, if transthoracic echocardiography is nondiagnostic. ▪ Transesophageal echocardiography is recommended to diagnose infective endocarditis in patients with valvular heart disease and positive blood cultures, if transthoracic echocardiography is nondiagnostic. <p>Class IIa Transesophageal echocardiography is reasonable to diagnose possible infective endocarditis in patients with persistent staphylococcal bacteremia without a known source.</p> <p>Class IIb Transesophageal echocardiography might be considered to detect infective endocarditis in patients with nosocomial staphylococcal bacteremia.</p>
56.	Persistent fever in patient with intra-cardiac device	None
Use of TEE as the Initial Test* - Common Uses - Atrial Fibrillation/Flutter		
57.	Evaluation of patient with atrial fibrillation/flutter to facilitate clinical decision making with regards to anticoagulation and/or cardioversion and/or radiofrequency ablation	<p>Echocardiography (p. 49) Cardioversion of patients with atrial fibrillation Recommendations for Echocardiography Before Cardioversion Class I</p> <ul style="list-style-type: none"> • Patients who have had prior cardioembolic events thought to be related to intra-atrial thrombus.* • Patients for whom intra-atrial thrombus has been demonstrated in previous TEE.* • Evaluation of patients for whom a decision concerning cardioversion will be impacted by knowledge of prognostic factors (such as LV function or coexistent mitral valve disease). <p>*TEE only.</p>
58.	Evaluation of patient with atrial fibrillation/flutter for left atrial thrombus or spontaneous contrast when a	None

	decision has been made to anticoagulate and not to perform cardioversion	
Use of TEE – Embolic Event		
59.	Evaluation for cardiovascular source of embolic event in a patient who has a normal transthoracic echo and normal electrocardiogram and no history of atrial fibrillation/flutter	None

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