Transesophageal Echocardiography (TEE)

ACG: A-0112 (AC)
Link to Codes

MCG Health
Ambulatory Care
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Clinical Indications

- Transesophageal echocardiogram (TEE) may be indicated for **1 or more** of the following(1)(2)(3)(4):
  - Acute thoracic aortic pathology, suspected (eg, dissection, transection)(9)(10)(11)(12)(13)(14)N
  - Atrial fibrillation or atrial flutter, when results will facilitate clinical decision making regarding treatment(21)(22)N
  - Cardiac tumor or mass, known or suspected, as indicated by **1 or more** of the following(31):N
    - Need for further characterization of known mass (eg, morphology, site of attachment)(16)(32)
    - Valvular mass, known or suspected
  - Congenital heart disease, as indicated by **1 or more** of the following(33)(34)(35)(36):N
    - Diagnostic evaluation needed, as indicated by **1 or more** of the following:
      - Evaluation for cardiovascular source of embolus with no identified noncardiac source
      - Evaluation for intracardiac thrombus prior to cardioversion
      - Evaluation of intracardiac or extracardiac baffles following Fontan, Senning, or Mustard procedure

- Evaluation of status of prosthetic valve in setting of inadequate transthoracic echocardiogram images
- Intracardiac evaluation for vegetation or suspected abscess
- Pericardial effusion or cardiac function evaluation and monitoring of postoperative patient with open sternum or poor acoustic windows
- Presence of patent foramen ovale, and need to evaluate direction of shunting as possible etiology for stroke(38)
- Suspected acute aortic pathology (eg, Marfan syndrome, bicuspid aortic valve, coarctation of aorta)(9)
- Suspected congenital heart disease and nondiagnostic transthoracic echocardiogram
- Re-evaluation of prior TEE for interval change (eg, resolution of vegetation after antibiotic therapy)

▪ Intervention needed, as indicated by **1 or more** of the following(39):

- Assessment of results of minimally invasive surgical incision or video-assisted cardiac procedure
- Guidance during percutaneous valve intervention(40)
- Guidance during placement of catheter-based cardiac assist device(41)
- Guidance during radiofrequency ablation procedure
- Guidance for blade or balloon atrial septostomy
- Guidance for creation/stenting of interventricular communication
- Guidance for placement of occlusion device (eg, septal defect, Fontan, or intra-atrial baffle fenestration)(37)(42)

▪ Perioperative evaluation needed, as indicated by **1 or more** of the following(40)(41)(43):

- Immediate preoperative definition of cardiac anatomy and function
- Intraoperative monitoring of ventricular volume and function
- Monitoring of intracardiac/intravascular air and adequacy of cardiac de-airing
- Postoperative cardiac surgical results and function

− Endocarditis, as indicated by **1 or more** of the following(24)(44)(45)(46)(47):N

- Atrial or ventricular arrhythmias
- Atrioventricular conduction block on ECG
- Clinical suspicion of endocarditis, and transthoracic echocardiogram results are nondiagnostic(53)(54)(55)(56)(57)(58)(59)(60)
- Fungemia
- Intracardiac device leads are present (eg, pacemaker, implantable cardioverter-defibrillator).(55)(58)(59)(61)
- Libman-Sacks endocarditis, suspected, in patient with systemic lupus erythematosus(62)(63)
- Persistent Fever in patient with known infective endocarditis on appropriate treatment(55)(60)
- Persistent Fever in patient with prosthetic heart valve(53)(55)(58)(61)(64)
- *Staphylococcus aureus* bacteremia(49)(65)

− Guidance for percutaneous noncoronary cardiac interventions, as indicated by **1 or more** of the following(36)(66)(67)(68)(69):N

- Balloon or blade atrial septostomy
- Closure of atrial or ventricular septal defect or patent foramen ovale(6)(38)(72)(73)
- Left atrial appendage occlusion(23)(28)(74)(75)
- Mitral valvuloplasty(76)(77)
- Radiofrequency ablation(28)(78)
- Septal ablation for hypertrophic cardiomyopathy(79)(80)
- Transcatheter aortic valve implantation(46)(81)(82)(83)(84)
- Transcatheter mitral valve repair or replacement(45)(46)(82)(85)(86)
- Transcatheter tricuspid valve repair(84)(87)(88)(89)
- Transseptal puncture

○ Intraoperative monitoring (eg, aortic surgery, cardiac transplant, cardiac valvular surgery, surgical myectomy)(9)(34)(90)(91)(92)(93)(94)(95)N

- Kawasaki disease, known, and transthoracic echocardiogram is inadequate or nondiagnostic(102)
- Nondiagnostic transthoracic echocardiogram, or high likelihood due to unfavorable patient characteristics or anticipated suboptimal visualization of relevant structures(13)(36)(79)(103)(104)
- Pericardial disease, known or suspected(92)(107)
- Persistent Fever or suspected thrombus in patient with intracardiac device (eg, pacemaker, implantable defibrillator)(58)(108)
- Re-evaluation after previous TEE, when results would alter management (eg, anticoagulation or antibiotic treatment)

− Systemic embolism with suspected cardioembolic cause, as indicated by **ALL** of the following(109)(110)(111):

- Clinical evidence of systemic embolism, as indicated by **1 or more** of the following(117):
  - Stroke or transient ischemic attack
  - Sudden onset of acute renal ischemia
  - Sudden onset of lower limb ischemia
  - Sudden onset of mesenteric ischemia
  - Sudden onset of multiorgan system arterial occlusions
  - Sudden onset of splenic ischemia(118)
  - Sudden onset of upper extremity ischemia
- Normal or indeterminate transthoracic echocardiogram results

− Valvular heart disease, known, as indicated by **1 or more** of the following(45)(46)(54)(68)(69)(84)(92):

- Aortic regurgitation, and other noninvasive imaging (eg, transthoracic echocardiography) is suboptimal or nondiagnostic(45)(82)(105)
- Mitral regurgitation (chronic and primary), and other noninvasive imaging (eg, transthoracic echocardiography) is suboptimal or nondiagnostic(79)(82)(99)(105)(122)(123)
- Mitral stenosis, and patient being considered for percutaneous mitral balloon commissurotomy(77)(123)
- Prosthetic valve dysfunction, known or suspected(45)(124)(125)(126)(127)
- To establish mechanism of valve regurgitation(105)
- To guide choice between valve repair and valve replacement for mitral regurgitation
- To guide transcatheter valve replacement or repair procedures(83)(86)(87)(88)(123)(128)
- Valvular mass, known or suspected(31)(121)

Alternatives

- Alternatives include(16)(25):
  - For suspected thoracic aorta pathology (eg, dissection): helical chest CT angiogram, cardiac CT, cardiac MRI, or MR angiography. See Chest CT Angiography (CTA) AC, Cardiac CT Scan AC, Cardiac MRI AC, and Chest MR Angiography (MRA) AC for further information.(9)(12)(19)(129)
  - Intracardiac echocardiography(130)(131)(132)(133)
  - Transthoracic echocardiography. See Transthoracic Echocardiography (TTE), Resting AC for further information.

Evidence Summary

Background

TEE is used to visualize the heart and great vessels via an ultrasound probe that is placed into the esophagus and stomach. It is an invasive procedure due to the need for esophageal intubation and requires intravenous access and conscious sedation.(3)(5)(6) **(EG 2)** TEE is generally reserved for situations in which

transthoracic echocardiography is insufficient for diagnosis or inadequate for visualization of certain structures.(1)(3)(4)(5) **(EG 2)** Three-dimensional TEE is now widely available and provides incremental information to traditional 2-dimensional methods, particularly when used to guide cardiac procedures.(3)(4)(7) **(EG 2)**

Criteria

The evidence for the clinical indications found in this guideline includes 91 published peer reviewed articles, 30 specialty society or other evidence-based guidelines, and 1 book section.

For acute thoracic aortic pathology, evidence demonstrates at least moderate certainty of at least moderate net benefit. **(RG A1)** TEE, transthoracic echocardiogram, CT scan, and MRI are all acceptable diagnostic imaging modalities for the evaluation of acute thoracic aortic pathology, including dissection and transection.(1)(9)(15)(16)(17) **(EG 2)** A systematic review of 82 studies involving 57,311 patients with acute aortic syndrome, including thoracic aortic dissection and intramural hematoma, found that TEE had a sensitivity of 86% to 100% for detection of acute aortic syndrome. The authors concluded that TEE is a reasonable alternative to CT scan and MRI for diagnosing acute aortic syndrome.(18) **(EG 1)** For detection of an intimal flap, the classic sign of aortic dissection, TEE has been found to have sensitivity of 100% and specificity of 100%, which is superior to the performance characteristics of conventional CT scan.(19) **(EG 2)** TEE is better able to identify aneurysms of the descending aorta, whereas aneurysms of the ascending aorta are better visualized by transthoracic echocardiogram.(1)(9) **(EG 2)** Three-dimensional Doppler TEE is safe and can be performed at the bedside for evaluation of the aorta.(9)(20) **(EG 2)**

For atrial fibrillation, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** The initial recommended test for new-onset atrial fibrillation is transthoracic echocardiogram, which is indicated for detection of structural heart disease or evidence of underlying ischemic heart disease.(21) **(EG 2)** A review article and a specialty society guideline note that TEE is considered the gold standard for identifying spontaneous echocardiographic contrast and thrombus formation in the left atrial appendage.(23)(24)(25) **(EG 2)** TEE is performed to rule out left atrial or left atrial appendage thrombus if cardioversion or radiofrequency ablation is planned.(1)(22)(26)(27)(28) **(EG 2)** A systematic review reported that TEE had a sensitivity between 82% and 100% in detecting pulmonary vein stenosis following catheter ablation of atrial fibrillation.(29) **(EG 2)** A prospective single-blind observational study of 43 patients undergoing ablation for paroxysmal or persistent atrial fibrillation found that the use of TEE was feasible for assessing pulmonary veins before and after the ablation procedure, and provided both anatomic and functional information that complemented cardiac CT.(30) **(EG 2)**

For a cardiac tumor or mass, known or suspected, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** A specialty society appropriate-use criteria statement recommends TEE for further evaluation of a cardiac mass seen on transthoracic echocardiography, noting it is an appropriate test to evaluate morphology of the mass and describe attachment and extension of the mass, and is especially well suited for the evaluation of valvular and left atrial masses.(31) **(EG 2)**

For congenital heart disease, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** Specialty society guidelines state that TEE is useful for the evaluation of multiple forms of congenital heart disease. This includes the evaluation of pulmonary venous connections in adults with atrial septal defect, of the thoracic aorta in patients with Williams syndrome or patients suspected of having supravalvular aortic stenosis, and of Ebstein anomaly in patients in whom surgical intervention is planned but transthoracic echocardiography images are inadequate. The authors note that TEE is superior to transthoracic echocardiography for visualization of the full extent of supravalvular aortic stenosis.(33)(37) **(EG 2)** A review article notes that diagnostic applications of TEE in pediatric patients with congenital heart disease include assessment of venous pathways in patients with transposition of the great arteries following surgical correction procedures, aortic root assessment in patients with repaired tetralogy of Fallot and other conditions associated with aortic root enlargement, and assessment of ventricular and valvular function following Fontan surgery.(34) **(EG 2)** A specialty society practice guideline on pediatric TEE notes that TEE is useful in the diagnostic, guided intervention, and perioperative settings.(36) **(EG 2)**

For endocarditis, evidence demonstrates at least moderate certainty of at least moderate net benefit. **(RG A1)** TEE is indicated if a high clinical suspicion exists; however, there is no demonstrated benefit to TEE when the pretest probability of endocarditis is low.(1)(48) **(EG 2)** A systematic review of 9 studies with a total of 3513 patients concluded that TEE is indicated in most patients with *Staphylococcus aureus* bacteremia.(49) **(EG 1)** TEE has a higher sensitivity for periannular complications of endocarditis than does transthoracic echocardiogram (100% vs 22%, respectively).(1) **(EG 2)** While transthoracic echocardiography is commonly

used as a first-line imaging test in cases of suspected endocarditis, a retrospective analysis reported that only 45% of vegetations were detected by transthoracic echocardiography as compared with TEE.(50) **(EG 2)** A meta-analysis of 16 studies including 2807 patients with suspected infective endocarditis found that standard transthoracic echocardiography had a sensitivity of only 61% for detection of vegetations as compared with TEE.(51) **(EG 1)** A review article notes that TEE is used in most patients with suspected infective endocarditis due to its higher sensitivity.(52) **(EG 2)** Specialty society guidelines state that TEE is recommended in all patients with known or suspected infective endocarditis when transthoracic echocardiography is nondiagnostic, when complications are present or are suspected clinically, when a prosthetic valve is present, or when intracardiac device leads are present.(24)(44)(45) **(EG 2)**

For guidance of percutaneous noncoronary cardiac interventions, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** Appropriate-use criteria statements endorsed by multiple specialty societies note that TEE is appropriate for guidance of these procedures, including radiofrequency ablation, percutaneous valve procedures, and closure device placement, among others.(1)(16) **(EG 2)** A prospective study of 205 patients undergoing transseptal puncture concluded that TEE was useful for guidance of this procedure and for avoidance of procedural complications.(70) **(EG 2)** A retrospective observational study of 12,043 adults who underwent TEE for transcatheter structural cardiac interventions found that 3.6% had a major complication (eg, hemorrhage, esophageal injury) within 72 hours of the procedure, with significantly higher rates of complications found in patients age 65 years or older and patients on anticoagulation or antiplatelet therapy.(71) **(EG 2)** A review article concluded that 3-dimensional TEE, in particular, is most useful for transseptal puncture, patent foramen ovale or atrial septal defect closure, left atrial appendage occlusion, mitral valve repair, and closure of paravalvular leaks.(67) **(EG 2)**

For intraoperative monitoring, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** A specialty society guideline notes that intraoperative TEE should be performed in patients undergoing coronary artery bypass graft surgery who require evaluation of acute and persistent life-threatening hemodynamic disturbances that have not responded to treatment; intraoperative TEE should also be performed in patients undergoing concomitant cardiac valvular surgery.(96) **(EG 2)** A case control study including 2037 TEEs in patients undergoing surgical mitral valve repair found that echo-guided repair was associated with a higher rate of initial success than unguided repair; these authors found that 3-dimensional TEE in particular improved concordance, which was associated with successful repair.(97) **(EG 2)** Review articles and a specialty society guideline state that TEE is necessary during surgical mitral valve repair in order to provide real-time detailed pre-repair and postrepair assessment.(45)(84)(86)(94) **(EG 2)** A specialty society scientific statement notes that TEE can improve patient outcomes in aortic surgery for aortic dissection.(95) **(EG 2)** A review article notes that TEE evaluation of endoleaks during endovascular aortic procedures can lead to early detection and immediate corrective interventions.(98) **(EG 2)** A specialty society guideline states that TEE is necessary to ensure that left atrial appendage exclusion is successful in high-risk patients with atrial fibrillation undergoing concurrent cardiac surgery.(21) **(EG 2)** Specialty society guidelines recommend the use of intraoperative TEE for guidance of surgical myectomy in patients with hypertrophic cardiomyopathy.(79)(80)(99) **(EG 2)** Specialty society guidelines recommend the use of intraoperative TEE in patients undergoing cardiac valvular surgery due to infective endocarditis.(45)(47) **(EG 2)** A review article notes that intraoperative TEE is commonly used during pediatric cardiac surgery, including orthotopic heart transplant, as intraoperative assessment allows for evaluation of graft function immediately after implantation and reperfusion, as well as assessment of valvular regurgitation and examination of anastomotic sites.(90) **(EG 2)** Specialty society guidelines state that intraoperative TEE is recommended to guide surgical repair of congenital heart disease in adult patients.(33)(95) **(EG 2)** A specialty society guideline and a review article recommend the use of TEE during noncardiac surgical procedures, such as orthotopic liver transplant, during which severe hemodynamic compromise may occur.(91)(93) **(EG 2)** Another review article notes that TEE has multiple applications during orthotopic liver transplant, including assistance in the placement of pulmonary artery catheters, guidance of veno-venous bypass placement, evaluation of surgical liver anastomosis patency, and assessment of acute hypoxemia.(100) **(EG 2)** A randomized trial of 80 patients undergoing radical cystectomy found that the use of TEE for intraoperative monitoring reduced the use of central line insertion, the incidence of perioperative complications, and the duration of intubation.(101) **(EG 1)** A specialty society guideline recommends intraoperative TEE in adults in all open heart procedures and thoracic aortic surgical procedures, and consideration of its use in coronary artery bypass graft surgery; use in small children is recommended on a case-by-case basis. It also recommends considering TEE in noncardiac surgery when the nature of the surgery or the patient's cardiovascular pathology may result in severe compromise of the patient's hemodynamic, pulmonary, or neurologic physiology.(66) **(EG 2)**

For Kawasaki disease, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** A specialty society guideline states that TEE, cardiac CTA, and cardiac MRI can be useful for the evaluation of older children and adolescents with Kawasaki disease in whom visualization of the coronary arteries with transthoracic echocardiography is inadequate.(102) **(EG 2)**

For nondiagnostic transthoracic echocardiogram, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** Specialty society guidelines state that TEE is indicated for evaluation when transthoracic echocardiogram is nondiagnostic or is reasonably expected to be nondiagnostic.(1)(45)(79)(105)(106) **(EG 2)**

For pericardial disease, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** Clinical guidelines endorsed by multiple specialty societies note that TEE is the best imaging modality to confirm the presence of cardiac tamponade and to assess for pericardial thickness and right atrial tethering due to pericardial disease.(92)(107) **(EG 2)**

For persistent fever or suspected thrombus in a patient with an intracardiac device, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** An appropriate-use criteria statement endorsed by multiple specialty societies notes that TEE is appropriate for the evaluation of thrombus or of suspected endocarditis in patients with intracardiac devices.(1) **(EG 2)** A specialty society guideline states that TEE is recommended in all patients with known or suspected infective endocarditis when intracardiac device leads are present.(45) **(EG 2)**

For re-evaluation after previous TEE, evidence demonstrates a net benefit, but of less than moderate certainty, and may consist of a consensus opinion of experts, case studies, and common standard care. **(RG A2)** Appropriate-use criteria statements endorsed by multiple specialty societies note that TEE is appropriate for re-evaluation of previous findings following a treatment intervention, such as anticoagulation or antibiotic treatment.(1)(16)(21)(24)(45) **(EG 2)**

For systemic embolism, evidence demonstrates at least moderate certainty of at least moderate net benefit. **(RG A1)** TEE is useful for detecting an underlying cardiovascular etiology, such as mural thrombus, patent foramen ovale, atrial septal defect, or neoplasm.(1)(16)(24)(112)(113) **(EG 2)** A prospective cohort study of 494 patients with acute ischemic stroke or transient ischemic attack of undetermined cause found that TEE imaging was associated with a higher rate of treatment-relevant findings, as compared with transthoracic echocardiography imaging; TEE imaging led to a change in the assessment of stroke cause in 11.5% of patients.(114) **(EG 2)** A prospective study of 61 patients with embolic stroke of undetermined source found that TEE revealed additional findings in 52% of the study population, and TEE findings changed management in 16% of patients.(115) **(EG 2)** A retrospective study of 1833 patients with ischemic stroke who were in sinus rhythm and had no history of cardiac disease found that TEE revealed potential sources of embolism or aortic plaque in 41.1% of patients and that changes in patient management would be necessary in 3.4% of patients.(116) **(EG 2)**

For valvular heart disease, evidence demonstrates at least moderate certainty of at least moderate net benefit. **(RG A1)** A specialty society guideline states that TEE is recommended in all patients when clinical signs or symptoms suggest prosthetic valve dysfunction, noting that both transthoracic echocardiography and TEE are needed for complete evaluation in this scenario due to the different valvular imaging angles afforded by each modality. This specialty society guideline further states that TEE should be performed in all pregnant patients with a mechanical prosthetic valve who have prosthetic valve obstruction or experience an embolic event.(45) **(EG 2)** A review article notes that intraprocedural TEE can provide real-time imaging guidance during transcatheter aortic valve replacement and may contribute to improving procedural results.(119) **(EG 2)** Transthoracic echocardiogram and TEE are equally effective for identification of mitral stenosis; however, TEE is the first-line option for determining the etiology of aortic or mitral regurgitation and assessing the appropriateness and feasibility of valve repair.(1) **(EG 2)** A specialty society guideline states that TEE should be performed in patients with mitral stenosis who are being considered for percutaneous mitral balloon commissurotomy to assess for left atrial thrombus and to evaluate the severity of mitral regurgitation. This specialty society guideline also states that TEE is indicated for evaluation of patients with chronic primary mitral regurgitation in whom other noninvasive imaging (such as transthoracic echocardiogram or cardiac MRI) is nondiagnostic with regard to severity of regurgitation, left ventricular function, and mechanism of regurgitation.(45) **(EG 2)** A specialty society guideline states that TEE is useful for evaluating the etiology and severity of valvular regurgitation when transthoracic echocardiography is nondiagnostic or suboptimal.(105)(120) **(EG 2)** A systematic review of echocardiographic findings after cerebrovascular events in the setting of cardiac papillary fibroelastoma identified 161 cases (73.2% of which were valvular masses) and found that 10.6% of tumors identified by TEE were missed by transthoracic echocardiogram (TTE).(121) **(EG 1)** Appropriate-use criteria endorsed by multiple specialty societies state that TEE is appropriate for further evaluation of valvular masses, including incidental findings noted on noncardiac imaging studies.(46) **(EG 2)**

Inconclusive or Non-Supportive Evidence

For acute chest pain suggestive of acute coronary syndrome, evidence is insufficient, conflicting, or poor and demonstrates an incomplete assessment of net benefit vs harm; additional research is recommended. **(RG B)** A specialty society guideline states that because the information that can be added is limited, TEE is generally not indicated in the examination of patients with acute chest pain suggestive of acute coronary syndrome.(8) **(EG 2)**

Rationale

Use of this MCG care guideline helps the clinician determine if a particular treatment, medication, or service might be appropriate for a specific patient, taking into account their unique health complexities.

Use of these evidence-based clinical criteria to support decision making benefits the patient by identifying patient-specific complex clinical factors and conditions, promoting personalized treatment. Utilizing evidence-based clinical criteria promotes patient safety by helping ensure that potential patient benefits outweigh the risks. In addition, the use of evidence-based guidelines can increase consistency in treatment thresholds, leading to less variation in care and promoting equitable treatment among patients.

Related CMS Coverage Guidance

This guideline supplements but does not replace, modify, or supersede existing Medicare regulations or applicable National Coverage Determinations (NCDs) or Local Coverage Determinations (LCDs).

Code of Federal Regulations (CFR): 42 CFR 419.22(134); 42 CFR 422.101(135)

Internet-Only Manual (IOM) Citations: CMS IOM Publication 100-02, Medicare Benefit Policy Manual, Chapter 14 - Medical Devices(136); CMS IOM Publication 100-02, Medicare Benefit Policy Manual, Chapter 15 - Covered Medical and Other Health Services(137); CMS IOM Publication 100-02, Medicare Benefit Policy Manual, Chapter 16 - General Exclusions from Coverage(138)

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Definitions

Fever

- Fever is defined as a core[A] temperature greater than or equal to 100.4 degrees F (38 degrees C).[B](2)(3)

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Footnotes

A. While a rectal temperature can be considered a core reading, it is not always practical. Tympanic membrane temperature is not usually considered a core reading; however, the devices that measure this temperature often are (or can be) programmed so that they automatically adjust readings to reflect a core temperature equivalent.(1)
B. There is not a universally accepted definition of fever, as various temperatures are proposed as the cutoff that constitutes a fever.

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