National Imaging Associates, Inc.*	
Clinical guidelines **HEART (Cardiac) PET with CT for Attenuation**	**Original Date: July 1999**
CPT Codes: 78459, 78491, 78492, +78434, 78429, 78430, 78431, 78432, 78433	**Last Revised Date: ~~March~~ February 2021~~1~~**
Guideline Number: NIA_CG_079	**Implementation Date: January 2023~~2~~**

GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.

This guideline is for stress imaging, specifically Heart (Cardiac) PET imaging, with appropriate preference for suitable alternatives, such as stress echocardiography (SE) or myocardial perfusion imaging (MPI), when more suitable, unless otherwise stated (refer to Background section).

~~Indications for Heart~~INDICATIONS FOR HEART PET ~~with~~ WITH CT ~~for Attenuation~~FOR ATTENUATION

SUSPECTED CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)

- **Symptomatic patients without known CAD (use Diamond Forrester Table)**
  - Low **or intermediate** pretest probability and unable to exercise ***(SE diversion not required)***
  - ~~Intermediate pre-test probability with an uninterpretable electrocardiogram (ECG) or unable to exercise1 (Wolk, 2014)~~
  - High pretest probability ***(SE diversion not required)***
  - ~~Repeat testing in a patient with new or worsening symptoms and negative result~~ at least one year ago **AND** meets one of the criteria above
  -
- **Asymptomatic patients without known CAD *(SE diversion not required)***

* National Imaging Associates, Inc. (NIA) is a subsidiary of Magellan Healthcare, Inc.

1— Heart PET with CT for Attenuation

- Previously unevaluated ECG evidence of possible myocardial ischemia including substantial ischemic ST segment or T wave abnormalities (see section in Overview)
- Previously unevaluated pathologic Q waves (see section in Overview)
- Unevaluated complete left bundle branch block

ABNORMAL CALCIUM SCORES (CAC)[1-5] (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)

- **ASYMPTOMATIC patient with a calcium score >400, not previously evaluated**
- **SYMPTOMATIC patient with prior CAC ≥100**

~~History of diabetes mellitus, > 40 years old, with calcium score >400~~

INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)

- Exercise stress ECG with low--risk Duke treadmill score (≥5), (see section in Overview) but patient's current symptoms indicate an intermediate or high pretest probability *(SE diversion not required* for high pretest probability)
- Exercise stress ECG with an intermediate Duke treadmill score
- Inconclusive/borderline coronary computed tomography angiography (CCTA) (e.g., 43~~3~~40 - 70% lesions)
- Non-diagnostic exercise stress test with physical inability to achieve target heart rate (THR)- *(SE diversion not required)*
- An intermediate evaluation by prior stress imaging (within the past 2 years) *(SE diversion not required)*

FOLLOW-UP OF PATIENT'S POST CORONARY REVASCULARIZATION (PCI or CABG) (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)~~when LVEF is ≤ 40% and revascularization is under consideration~~

- **Asymptomatic, follow-up stress imaging** at a minimum of 2 years post coronary artery bypass grafting (CABG), or percutaneous coronary intervention (PCI), (whichever is later), is appropriate only for patients with a history of silent ischemia or a history of a prior left main stent
  OR
- For patients with high occupational risk (e.g., associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters)
- **New, recurrent, or worsening symptoms post coronary revascularization,** is an indication for stress imaging, if it will alter management

FOLLOW-UP OF KNOWN CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)

~~For assessment of suspected significant hibernating myocardium in the presence of known severe major vessel CAD, when EF is below 40%, in order to determine a patient's potential benefit from coronary revascularization[6-8] (Patel, 2013; Tsai, 2014; Yancy, 2013)~~

- ~~Routine follow~~Follow-up of asymptomatic or stable symptoms when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR ≤ 0.80 or stenosis greater than or equal to 70% of a major vessel), over two years ago, without intervening coronary revascularization is an appropriate indication for stress imaging in patients if it will alter management

SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)

- Prior acute coronary syndrome (as documented in MD notes), without subsequent invasive or non-invasive coronary evaluation
- Newly diagnosed systolic heart failure or diastolic heart failure, ~~(EF < 50%),~~ ***with reasonable suspicion of cardiac ischemia (prior events, risk factors)***, ~~*with especially with symptoms or signs of ischemia*~~ unless invasive coronary angiography is immediately planned[6-8] ~~(Fihn, 2012; Patel, 2013; Yancy, 2013)~~
- Reduced LVEF ≤ 50% requiring myocardial viability assessment to assist with decisions regarding coronary revascularization. (Diversion from PET not required when LVEF less than or equal to 40%)[7-9] ~~(Patel, 2013; Tsai, 2014; Yancy, 2013)~~
- Ventricular arrhythmias
    - Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise-induced VT, when invasive coronary arteriography is not the immediately planned test[10] ~~(Al Khatib, 2018)~~
    - Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, frequent PVC's (defined as greater than or equal to 30/hour on remote monitoring) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed
- Prior to Class IC antiarrhythmic drug initiation (Propafenone or Flecanide), as well as annually in intermediate and high global risk patients (SE diversion not required)[11] ~~(Reiffel, 2015)~~
- Assessment of hemodynamic significance of one of the following documented conditions[12] ~~(Anagnostopoulos, 2004)~~:
    - Anomalous coronary arteries[13] ~~(Grani, 2017)~~
    - ~~Muscle bridging of~~ Muscle bridging of coronary artery [3, 14] ~~coronary artery (perform with exercise stress)[14] (Sorajja, 2021)~~
- Coronary aneurysms in Kawasaki's disease[15] ~~(McCrindle, 2017)~~ or due to atherosclerosis
- Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter[16] ~~(Lancellotti, 2013)~~

- **Cardiac Sarcoidosis**[17-19] ~~(Birnie, 2016; Blankstein, 2016; Vita, 2018)~~
  - Evaluation and therapy monitoring in patients with sarcoidosis, after documentation of suspected cardiac involvement by echo or ECG, when CMR has not been performed
  - Evaluation of suspected cardiac sarcoid, after CMR has shown equivocal or negative findings in the setting of a high clinical suspicion[19] ~~(Vita, 2018)~~
  - Evaluation of CMR findings showing highly probable cardiac sarcoidosis, when PET could serve to identify inflammation and the consequent potential role for immunosuppressive therapy[19] ~~(Vita, 2018)~~
  - Initial and follow-up PET in monitoring therapy for cardiac sarcoid with immunosuppressive therapy, typically about 4 times over 2 years

- **Infective Endocarditis**
  - In suspected infective endocarditis with moderate to high probability (i.e., staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device), when TTE and TEE have been inconclusive with respect to diagnosis of infective endocarditis or characterization of paravalvular invasive complications[20-22] ~~(Doherty, 2017; Habib, 2016; Wang, 2018)~~

- **Aortitis**
  - For diagnosis and surveillance of Aortitis, PET/CT or PET/MRI‡ hybrid imaging[23] ~~(Bhave, 2018)~~
    ‡**NOTE:** If PET/MR study is requested, there is no specific CPT Code for this imaging study and a Health Plan review will be required.

PRIOR TO ELECTIVE NON-CARDIAC SURGERY (When neither SE nor MPI have provided or are expected to provide optimal imaging)

- **An i~~I~~ntermediate or high risk surgery with of one or more risk factors (see below), AND documentation of an inability to walk (or <4 METs) AND there has not been an imaging stress test within 1 year**[24-26]*

  - **Risk factors: history of ischemic heart disease, history of congestive heart failure, history of cerebrovascular disease, preoperative treatment with insulin, and preoperative serum creatinine >2.0 mg/dL.**
  - **Surgical Risk:**
    - **High risk surgery: Aortic and other major vascular surgery, p~~P~~eripheral vascular surgery, a~~A~~nticipated prolonged surgical procedures associated with large fluid shifts and/or blood loss**
    - **Intermediate risk surgery: Carotid endarterectomy, h~~H~~ead and neck surgery, i~~I~~ntraperitoneal and intrathoracic surgery, o~~O~~rthopedic surgery, p~~P~~rostate surgery**
    - **Low risk surgery: Endoscopic procedures, superficial procedure, cataract surgery, b~~B~~reast surgery**

- **Planning for any organ or stem cell transplantation is an indication for preoperative stress imaging~~MPI~~, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year, at the discretion of the transplant service**[27]

~~**PRIOR TO ELECTIVE NON-CARDIAC SURGERY (When neither SE nor MPI have provided or are expected to provide optimal imaging)**~~

- ~~Patients who have no other indication for a non-invasive coronary evaluation, but are referred for preoperative cardiac evaluation, are eligible for MPI if **all 4 criteria** are met:~~
  - ~~Surgery is supra-inguinal vascular, intrathoracic, or intra-abdominal~~

    ~~**AND**~~
  - ~~The patient has **at least one** of the additional cardiac complication risk factors:~~
    - ~~Ischemic Heart Disease~~
    - ~~History of stroke or TIA~~
    - ~~History of congestive heart failure or ejection fraction ≤ 35%~~
    - ~~Insulin-requiring diabetes mellitus~~
    - ~~Creatinine ≥ 2.0 mg/dl~~

    ~~**AND**~~
  - ~~The patient has limited functional capacity (< 4 METS), such as one of the following:~~
    - ~~Unable to take care of their activities of daily living (ADLs) or ambulate~~
    - ~~Unable to walk 2 blocks on level ground~~
    - ~~Unable to climb 1 flight of stairs~~

    ~~**AND**~~
  - ~~There has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year, and the results of such a test would be likely to substantially alter therapy and/or preclude proceeding with the intended surgery.~~

- ~~Planning for solid organ transplantation is an indication for preoperative MPI, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year and with ≥ 3 of the following risk factors (SE diversion not required)[24] (Lentine, 2012):~~
  - ~~Age > 60~~
  - ~~Smoking~~
  - ~~Hypertension~~
  - ~~Dyslipidemia~~
  - ~~Left ventricular hypertrophy~~
  - ~~1 year on dialysis (for renal transplant patients)~~
  - ~~Diabetes mellitus~~
  - ~~Prior ischemic heart disease~~

POST CARDIAC TRANSPLANT (SE diversion not required)[28]
~~(McArdle, 2012)~~

- **Annually, for the first five years post cardiac transplantation, in a patient not undergoing invasive coronary arteriography**
- **After the first five years post cardiac transplantation, patients with documented transplant coronary vasculopathy can be screened annually if invasive coronary arteriography is not planned**
- ~~Annually, for the first five years post cardiac transplantation, in patient not undergoing annual invasive coronary arteriography~~
- ~~After the first five years post cardiac transplantation:~~
    - ~~Patients with documented transplant coronary vasculopathy, can be screened annually if invasive coronary arteriography is not planned~~

BACKGROUND[29, 30]
~~(Bateman, 2016; Fazel, 2011)~~

Cardiac PET scanning, when used in conjunction with CT attenuation, includes evaluation of perfusion, function, viability, inflammation, anatomy, and risk stratification for cardiac-related events such as myocardial infarction and death. Maximum diagnostic accuracy of cardiac PET/CT is achieved when images are interpreted in conjunction with other relevant imaging, clinical information, and laboratory data.

PET Scan

- Indicated when all the criteria for MPI are met **AND** there is likely to be equivocal imaging results because of BMI or large breasts or implants or prior thoracic surgery or results of a prior MPI
- Can identify regions of myocardial viability with hibernating myocardium (viable, with poor flow and contractility) by imaging with fluorine18 (F-18) fluorodeoxyglucose (FDG or 18-FDG) for this purpose
- Useful in the evaluation of inflammation: e.g., evaluation and therapy monitoring in patients with sarcoidosis, after documentation of cardiac involvement by echo or electrocardiography (ECG), in place of, or subsequent to CMR if needed to help with an uncertain diagnosis

Coronary application of PET includes evaluation of **stable patients without known CAD**, who fall into two categories[3, 6, 31] ~~(Fihn, 2012; Montalescot, 2013; Wolk, 2014)~~

- **Asymptomatic**, for whom global risk of CAD events can be determined from coronary risk factors, using calculators available online (see websites for **Global Cardiovascular Risk Calculators** section).
- **Symptomatic,** for whom we estimate the pretest probability that their chest-related symptoms are due to clinically significant (≥ 50%) CAD (below):

The 3 Types of Chest Pain or Discomfort

- **Typical Angina (Definite)** is defined as including all **3** characteristics:
  - Substernal chest pain or discomfort with characteristic quality and duration
  - Provoked by exertion or emotional stress
  - Relieved by rest and/or nitroglycerine
- **Atypical Angina (Probable)** has only **2** of the above characteristics
- **Nonanginal Chest Pain/Discomfort** has only **0 - 1** of the above characteristics

The medical record should provide enough detail to establish the type of chest pain. From those details, The Pretest Probability of obstructive CAD is estimated from the Diamond Forrester Table below, recognizing that in some cases multiple additional coronary risk factors could increase pretest probability[3, 6]:

~~Once the type of chest pain has been established from the medical record, the Pretest Probability of CAD (meaning obstructive CAD defined as coronary arterial narrowing ≥ 50%) is~~

~~estimated from the **Diamond Forrester Table** below, recognizing that in some cases multiple additional coronary risk factors could increase pretest probability[3, 6] (Fihn, 2012; Wolk, 2014):~~

Diamond Forrester Table

Age (Years)	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain
≤ 39	Men	Intermediate	Intermediate	Low
	Women	Intermediate	Very low	Very low
40 – 49	Men	High	Intermediate	Intermediate
	Women	Intermediate	Low	Very low
50 – 59	Men	High	Intermediate	Intermediate
	Women	Intermediate	Intermediate	Low
≥ 60	Men	High	Intermediate	Intermediate
	Women	High	Intermediate	Intermediate

- **Very Low:** < 5% pretest probability, usually not requiring stress evaluation
- **Low:** 5 - 10% pretest probability of CAD
- **Intermediate:** 10% - 90% pretest probability of CAD
- **High: > 90% pretest probability of CAD**

OVERVIEW

ECG Stress Test Alone versus Stress Testing with Imaging

Prominent scenarios suitable for an ECG stress test WITHOUT imaging (i.e., exercise treadmill ECG test) require that the patient can exercise for at least 3 minutes of Bruce protocol with achievement of near maximal heart rate AND has an interpretable ECG for ischemia during exercise[3] ~~(Wolk, 2014)~~:

- The (symptomatic) low or intermediate pretest probability patient who can exercise and has an interpretable ECG[3] ~~(Wolk, 2014)~~
- The patient who is under evaluation for exercise-induced arrhythmia
- The patient who requires an entrance stress test ECG for a cardiac rehab program or for an exercise prescription
- For the evaluation of syncope or presyncope during exertion[32] ~~(Shen, 2017)~~

Duke Exercise ECG Treadmill Score

C~~c~~alculates risk from ECG treadmill alone[33] ~~(Mark, 1987)~~:

- The equation for calculating the Duke treadmill score (DTS) is: DTS = exercise time in minutes - (5 x ST deviation in mm or 0.1 mV increments) - (4 x exercise angina score), with angina score being 0 = none, 1 = non-limiting, and 2 = exercise-limiting.
- The score typically ranges from - 25 to + 15. These values correspond to low-risk (with a score of ≥ + 5), intermediate risk (with scores ranging from - 10 to + 4), and high-risk

(with a score of ≤ - 11) categories.

An uninterpretable baseline ECG includes[6] ~~(Fihn, 2012)~~:

- ST segment depression 1 mm or more (not for non-specific ST- T wave changes)
- Ischemic looking T waves; at least 2.5 mm inversions (excluding V1 and V2)
- LVH with repolarization abnormalities, pre-excitation pattern such as WPW, ventricular paced rhythm, or left bundle branch block
- Digitalis use with associated ST segment abnormalities

Previously unevaluated pathologic Q waves (in two contiguous leads) defined as the following:

- **> 40 ms (1 mm) wide**
- **> 2 mm deep**
- **> 25% of depth of QRS complex**

Global Risk of Cardiovascular Disease

Global risk of CAD is defined as the probability of manifesting cardiovascular disease over the next 10 years and refers to **asymptomatic** patients without known cardiovascular disease. It should be determined using one of the risk calculators below. A high risk is considered greater than a 20% risk of a cardiovascular event over the ensuing 10 years. **High global risk by itself generally lacks scientific support as an indication for stress imaging.** There are rare exemptions, such as patients requiring I-C antiarrhythmic drugs who might require coronary risk stratification prior to initiation of the drug. ~~or patients with a CAC score > 400 Agatston units, when global risk is moderate or high.~~

- **CAD Risk—Low**
  10-year absolute coronary or cardiovascular risk less than 10%
- **CAD Risk—Moderate**
  10-year absolute coronary or cardiovascular risk between 10% and 20%
- **CAD Risk—High**
  10-year absolute coronary or cardiovascular risk of greater than 20%

Websites for Global Cardiovascular Risk Calculators*

*Patients who have already manifested cardiovascular disease are already at high global risk and are not applicable to the calculators.[34-37] ~~(D'Agostino, 2008; Goff, 2014; McClelland, 2015; Ridker, 2007).~~

Risk Calculator	Websites for Online Calculator
Framingham Cardiovascular Risk	https://reference.medscape.com/calculator/framingham-cardiovascular-disease-risk
Reynolds Risk Score Can use if no diabetes Unique for use of family history	http://www.reynoldsriskscore.org/
Pooled Cohort Equation	http://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx?example
ACC/AHA Risk Calculator	http://tools.acc.org/ASCVD-Risk-Estimator/
MESA Risk Calculator With addition of Coronary Artery Calcium Score, for CAD-only risk	https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx

Definitions of Coronary Artery Disease[2, 6, 31]
~~(Fihn, 2012; Montalescot, 2013; Patel, 2017)~~

Percentage stenosis refers to the reduction in diameter stenosis when angiography is the method and can be estimated or measured using angiography or more accurately measured with intravascular ultrasound (IVUS).

- Coronary artery calcification is a marker of risk, as measured by Agatston score on coronary artery calcium imaging. ~~It is not a diagnostic tool so much as it is a **risk stratification** tool.~~ Its incorporation into global risk can be achieved by using the MESA risk calculator.
- Ischemia-producing disease (also called hemodynamically or functionally significant disease, for which revascularization might be appropriate) generally implies at least one of the following:
    - Suggested by percentage diameter stenosis ≥ 70% by angiography; **intermediate lesions are 50 – 69%**[38]~~borderline lesions are 40 – 70%[6] (Fihn, 2012)~~

    - For a left main artery, suggested by a percentage stenosis ≥ 50% or minimum lumen cross-sectional area on IVUS ≤ 6 square mm[6, 39] ~~(Fihn, 2012; Lofti, 2018)~~
    - FFR (fractional flow reserve) ≤ 0.80 for a major vessel[39] ~~(Lofti, 2018)~~
    - ~~iFR (instantaneous wave-free ratio) ≤ 0.89 for a major vessel[36-38] (Davies, 2017; Gotberg, 2017)~~
    - Demonstrable ischemic findings on stress testing (ECG or stress imaging), that are at least mild in degree
- A major vessel would be a coronary vessel that would be amenable to revascularization if indicated. This assessment is made based on the diameter of the vessel and/or the extent of myocardial territory served by the vessel.
- FFR (fractional flow reserve) is the distal to proximal pressure ratio across a coronary lesion during maximal hyperemia induced by either intravenous or intracoronary adenosine. Less than or equal to 0.80 is considered a significant reduction in coronary flow.
- ~~iFR (instantaneous wave-free ratio) measures the ratio of distal coronary to aortic pressure during the wave-free period of diastole, with a value ≤ 0.89 considered hemodynamically significant.[36-38] (Davies, 2017; Gotberg, 2017).~~
- Newer technology that estimates FFR from CCTA image is covered under the separate NIA Guideline for FFR-CT.

Anginal Equivalent[6, 32]
~~(Fihn, 2012; Shen, 2017)~~

Development of an anginal equivalent (e.g., shortness of breath, fatigue, or weakness) either with or without prior coronary revascularization should be based upon the documentation of reasons to suspect that symptoms other than chest discomfort are not due to other organ systems (e.g., dyspnea due to lung disease, fatigue due to anemia), by presentation of clinical data, such as respiratory rate, oximetry, lung exam, etc. (as well as d-dimer, chest CT(A), and/or PFTs, when appropriate), and then incorporated into the evaluation of coronary artery disease as would chest discomfort. Most syncope per se is not an anginal equivalent.

Abbreviations

ADLs	Activities of daily living
BMI	**Body mass index**
CABG	**Coronary artery bypass grafting**
CAC	**Coronary artery calcium**
CAD	Coronary artery disease
CCTA	**Coronary computed tomography angiography**
CMR	**Cardiac magnetic resonance imaging**
CT(A)	**Computed tomography (angiography)**
DTS	**Duke Treadmill Score**
ECG	Electrocardiogram

FFR	Fractional flow reserve
IVUS	**Intravascular ultrasound**
LBBB	Left bundle-branch block
LVEF	Left ventricular ejection fraction
LVH	Left ventricular hypertrophy
~~MI~~	~~Myocardial infarction~~ **MESA** **Multi-Ethnic Study of Atherosclerosis**
MET	Estimated metabolic equivalent of exercise
MI	**Myocardial infarction**
MPI	Myocardial perfusion imaging
MR(I)	**Magnetic resonance (imaging)**
PCI	**Percutaneous coronary intervention**
PET	**Positron emission tomography**
PFT	Pulmonary function test
PVCs	Premature ventricular contractions
SE	Stress echocardiography
TEE	**Transesophageal echocardiography**
THR	**Target heart rate**
TTE	**Transthoracic echocardiography**
~~VT~~	~~Ventricular tachycardia~~
VF	Ventricular fibrillation
VT	**Ventricular tachycardia**
WPW	**Wolff-Parkinson-White** ~~Wolf Parkinson White~~

Policy History

Date	Summary
February 2022	• ~~Brought~~Moved the sentence regarding utilization of suitable alternatives to the General Information section • Clarified evaluation of possible ischemia in newly diagnosed heart failure by stating *"with reasonable suspicion of cardiac ischemia (prior events, risk factors, or symptoms and signs)"* • Clarified "intermediate lesions are 50-69%" for ischemia-producing disease • Placed Link to Overview Section in General Information • Added stress imaging approval for calcium score > 100 with low to intermediate probability symptoms • Deleted the requirement for diabetes when calcium score > 400 for stress imaging • Added Calcium score section: o Added stress imaging approval for calcium score > 100 with symptoms consistent with low to intermediate pretest probability ~~Added Calcium score section~~ ~~Added SE diversion not required in section regarding 'An indeterminate (equivocal, borderline, or discordant) evaluation by prior stress imaging (SE or CMR) within the past 2 years'~~ • Added reminder *(SE diversion not required for CABG)* • Changed preoperative guideline to include intermediate risk surgery with one or more risk factors AND documentation of an inability to walk (or <4 METs) AND there has not been an imaging stress test within 1 year • Changed solid organ transplant guideline to include stem cell transplant and "any" organ transplant Added definition of surgical risk to preop guidelines~~Changed preoperative guideline to An Intermediate or high-risk surgery with of one or more risk factors AND documentation of an inability to walk (or <4 METs) AND there has not been an imaging stress test within 1 year*~~ ~~Changed solid organ transplant guideline~~ ~~Added risk factors for preop guidelines and definition of surgical risk~~ • • In Background section clarified the requirement for description of chest pain by adding sentence "The medical record should provide enough detail to establish the type of chest pain." " • Added definition of Q waves

	• Deleted sentence regarding calcium scoring within the Global Risk Section • Deleted sentence regarding using calcium score solely for risk stratification • Deleted redundant statement on viability • Deleted IFR references
March 2021	• Added annual indication for IC antiarrhythmics • Added History of diabetes mellitus, > 40 years old, with calcium score >400
March 2020	• The following statement was added to reflect an additional CPT code: Cardiac PET scanning, when used in conjunction with CT attenuation, includes evaluation of perfusion, function, viability, inflammation, anatomy, and risk stratification for cardiac-related events such as myocardial infarction and death. Maximum diagnostic accuracy of cardiac PET/CT is achieved when images are interpreted in conjunction with other relevant imaging, clinical information, and laboratory data. • Added general information section as Introduction which outlines requirements for documentation of pertinent office notes by a licensed clinician, and inclusion of laboratory testing and relevant imaging results for case review • Added clarification of repeat testing in a patient with new or worsening symptoms and negative result at least one year prior to include the statement "AND meets one of the criteria above" • Added clarification of frequent PVCs under ventricular arrhythmias which states defined as greater than or equal to 30/hour to include "on remote monitoring" • Edited indication of planning for solid organ transplantation to remove the requirement of limited functional capacity but maintaining requirement of ≥ 3 listed risk factors • Edits to the Background section include the following: o Indication changed to read as follows: PET is indicated when all the criteria for MPI are met AND There is likely to be equivocal imaging results because of BMI or large breasts or implants or prior thoracic surgery or results of a prior MPI • Removed the statement regarding radiation burden • Added edits to the Coronary Artery disease definition section • Updated and added new references

REFERENCES

Al-Khatib SM, Stevenson WG, Ackerman MUJ, et al. 2017 AHA/ACC/HRS Guideline for management of patients with ventricular Arrhythmias and the prevention of sudden cardiac death. *J Am Coll Cardiol.* 2018 Oct 2; 72(14):e91-e220.

Anagnostopoulos C, Harbison M, Kelion A, et al. Procedure guidelines for radionuclide myocardial perfusion imaging. *Heart*. 2004; 90:i1-i10. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1876307/pdf/v090p000i1.pdf.

Bateman TM, Dilsizian V, Beanlands RS, et al. American Society of Nuclear Cardiology and Society of Nuclear Medicine and Molecular Imaging Joint Position Statement on the Clinical Indications for Myocardial Perfusion PET. *J Nucl Med*. 2016; 1-3. Available at http://jnm.snmjournals.org/content/early/2016/08/24/jnumed.116.180448.full.pdf Retrieved May 16, 2018.

Bhave NM, Nienaber CA, Clough RE, et al. Multimodality imaging of thoracic aortic diseases in adults. *J Am Coll Cardiol Cardiovascular Imaging*. 2018;11(6):903-919.

Birnie DH1, Nery PB2, Ha AC3, Beanlands RS2. Cardiac Sarcoidosis. *J Am Coll Cardiol*. 2016 Jul 26; 68(4):411-21. doi: 10.1016/j.jacc.2016.03.605.

Blankstein R, Waller AH. Evaluation of Known or Suspected Cardiac Sarcoidosis. *Circ Cardiovasc Imaging*. 2016; 9:e000867.

D'Agostino RB Sr, Vasan RS, Pencina MJ, et al. General Cardiovascular Risk Profile for Use in Primary Care: The Framingham Heart Study. *Circulation*. 2008; 117:743-753.

Davies JE, Sen S, Dehbi HM, et al. Use of the instantaneous wave-free ratio or fractional flow reserve in PCI. *N Engl J Med*. 2017; 376:1824–34.

Doherty JU, Kort S, Mehran R. et al, ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2017 Appropriate use criteria for multimodality imaging in valvular heart disease: A report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2017;70(13):1647-1672.

Fazel R, Dilsizian V, Einstein, AJ, et al. ASNC Information Statement, Strategies for defining an optimal risk-benefit ratio for stress myocardial perfusion SPECT. J Nucl Cardiol. *Epub*: 24 March 2011: 1-8. Available at:

https://www.asnc.org/files/Optimal%20Risk-Benefit%20Ratio%20for%20SPECT.pdf.

Fihn SD, Gardin JM, Abrams J, et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the diagnosis and management of patients with stable ischemic heart disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American College of Physicians, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *Circulation.* 2012; 126(25):e354-471.

Goff DC, Lloyd-Jones, DM, Bennett G, et al. 2013 ACC/AHA Guideline on the assessment of cardiovascular ris:, A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation, American Society for Preventive Cardiology, American Society of Hypertension, Association of Black Cardiologists, National Lipid Association, Preventive Cardiovascular Nurses Association, and WomenHeart: The National Coalition for Women With Heart Disease. *J Am Coll Cardiol.* 2014; 63(25):2935-2959.

Götberg M, Christiansen EH, Gudmundsdottir IJ, et al. Instantaneous wave-free ratio versus fractional flow reserve to guide PCI. *N Engl J Med.* 2017; 376:1813–23.

Götberg M, Cook CM, Sen S, et al. The evolving future of instantaneous wave-free ratio and fractional flow reserve. *J Am Coll Cardiol.* 2017; 70(11):1379-1402.

Grani C, Buechel RR, Kaufmann PA, et al. Multimodality imaging in individuals with anomalous coronary arteries. *J Am Coll Cardiol.* 2017; 10(4):471-581.

Habib G, Lancellotti P, Antunes MJ, et al. 2015 ESC Guidelines for the management of infective endocarditis; The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). *Eur Heart J.* 2015; 36:3075–3123.

Hendel RC, Berman DS, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate use criteria for cardiac radionuclide imaging: A report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the American Society of Nuclear Cardiology, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the Society of Cardiovascular Computed Tomography, the Society for Cardiovascular Magnetic Resonance, and the Society of Nuclear Medicine. *J Am Coll Cardiol.* 2009; 53(23):2201-2229.

Hirshfeld JW, Ferrari VA, Bengel FM, et al. 2018 ACC/HRS/NASCI/SCAI/SCCT Expert consensus document on optimal use of ionizing radiation in cardiovascular imaging: Best practices for safety and effectiveness: A report of the American College of Cardiology Task Force on Expert Consensus Decision Pathways Developed in Collaboration with Mended Hearts. *J Am Coll Cardiol.* 2018 June; 71(24).

Lancellotti P, Knomo VT, Badano LP, et al. Expert consensus for multi-modality imaging evaluation of cardiovascular complications of radiotherapy in adults: A report from the European Association of Cardiovascular Imaging and the American Society of Echocardiography. *Eur Heart J Cardiovasc Imaging*. 2013; 14:721–740.

Lentine KL, Costa SP, Weir MR. Cardiac disease evaluation and management among kidney and liver transplantation candidates. *J Am Coll Cardiol*. 2012; 60(5):434-480.

Lotfi A, Davies JE, Fearon WF, Grines CL, Kern MJ, Klein LW. Focused update of expert consensus statement: Use of invasive assessments of coronary physiology and structure: A position statement of the society of cardiac angiography and interventions. *Catheter Cardiovasc Interv*. 2018 Jul 3.

Mark DB, Hlatky MA, Harrell FE Jr, Lee KL, Califf RM, Pryor DB. (1987) Exercise treadmill score for predicting prognosis in coronary artery disease. *Ann Intern Med*; 106(6):793-800.

McArdle BA, Dowsley TF, deKemp RA, et al. Does rubidium-82 have superior accuracy to SPECT perfusion imaging for the diagnosis of obstructive coronary disease? A systematic review and meta-analysis. *J Am Coll Cardiol*. 2012; 60: 1828–1837. Available at: https://www.sciencedirect.com/science/article/pii/S0735109712030471?via%3Dihub.

McClelland RL, Jorgensen NW, Budoff M, et al. 10-year coronary heart disease risk prediction using coronary artery calcium and traditional risk factors: Derivation in the MESA (Multi-Ethnic Study of Atherosclerosis) with validation in the HNR (Heinz Nixdorf Recall) Study and the DHS (Dallas Heart Study). *JACC*. 2015; 66(15):1643-53.

McCrindle BW, Rowley AH, Newburger JW, et al. Diagnosis, treatment, and long-term management of Kawasaki disease: A scientific statement for health professionals From the American Heart Association. *Circulation*. 2017; 135(17):e927.

Montalescot G, Sechtem U, Achenbach S., et al. 2013 ESC guidelines on the management of stable coronary artery disease: The Task Force on the management of stable coronary artery disease of the European Society of Cardiology. *Eur Heart J*. 2013; 34(38): 2949–3003. Available at: https://academic.oup.com/eurheartj/article/34/38/2949/442952.

Osborne MT, Hulte EA, Singh A, et al. Reduction in 18F-fluorodeoxyglucose uptake on serial cardiac positron emission tomography is associated with improved left ventricular ejection fraction in patients with cardiac sarcoidosis. *J Nucl Cardiol*. 2014;21(1):166-174.

Parker MW, Iskandar A, Limone B, et al. Diagnostic accuracy of cardiac positron emission tomography versus single photon emission computed tomography for coronary artery disease: A bivariate meta-analysis. *Circ Cardiovascular Imaging*. 2012; 5:700–707.

Patel MR, Bailey SR, Bonow RO, et al. ACCF/SCAI/AATS/AHA/ASE/ASNC/HFSA/HRS/SCCM/

SCCT/SCMR/STS Appropriate use criteria for diagnostic catheterization: A report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, Society for Cardiovascular Angiography and Interventions, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society of Critical Care Medicine, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2012; 59(22):1995-2027.

Patel MR, Calhoon JH, Dehmer GJ, et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate use criteria for coronary revascularization in patients with stable ischemic heart disease. *J Am Coll Cardiol*. 2017; 69(17):2212-2241.

Patel MR, White RD, Abbara S, et al. ACCF/ACR/ASE/ASNC/SCCT/SCMR Appropriate utilization of cardiovascular imaging in heart failure: A joint report of the American College of Radiology Appropriateness Criteria Committee and the American College of Cardiology Foundation Appropriate Use Criteria Task Force. *J Am Coll Cardiol*. 2013; 61(21):2207-2231.

Rahbar K, Seifarth H, Schäfers M, et al. Differentiation of malignant and benign cardiac tumors using 18F-FDG PET/CT. *J Nucl Med*. 2012;53(6):856-63.

Reiffel JA, Camm AJ, Belardinelli L, et al. The HARMONY Trial: Combined ranolazine and dronedarone in the management of paroxysmal atrial fibrillation: Mechanistic and therapeutic synergism. *Circ Arrhythm Electrophysiol*. 2015; 8(5):1048.

Ridker PM, Buring JE, Rifai N, et al. NIH Estimate of 10 Year coronary artery disease risk from Framingham Risk Score: Development and validation of improved algorithms for the assessment of global cardiovascular risk in women: the Reynolds Risk Score. *JAMA. 2007; 297(6):611-619. Available at:* http://jama.jamanetwork.com/article.aspx?articleid=205528.

Salaun E, Habib G. Beyond standard echocardiography in infective endocarditis: computed tomography, 3-dimensional imaging, and multi-imaging. *Circ Cardiovasc Imaging*. 2018; 11(3):1-4. Available at: http://circimaging.ahajournals.org/content/11/3/e007626.

Schindler, TH, Schelbert, HR, Quercioli, A, et al. Cardiac PET imaging for the detection and monitoring of coronary artery disease and microvascular health. *J Am Coll Cardiol Imaging*. 2010; 3(6):623-640.

Shen W, Sheldon RS, Benditt DG, et al. 2017 ACC/AHA/HRS Guideline for the evaluation and management of patients with syncope: A report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. *J Am Coll Cardiol*. 2017;70(5): 620-663.

Sorajja P, Iskandrian A, Tarantini G. Myocardial bridging of the coronary arteries. UpToDate. Published July 2021. Accessed August 13, 2021. https://www.uptodate.com/contents/myocardial-bridging-of-the-coronary-arteries.

Tsai JP, Yun CH, Wu TH, et al. A meta-analysis comparing SPECT with PET for the assessment of myocardial viability in patients with coronary artery disease. *Nucl Med Commun*. 2014; 35(9):947-54.

Vita T, Okada DR, Veillet-Chowdhury M, et al. Complementary value of cardiac magnetic resonance imaging and positron emission tomography/computed tomography in the assessment of cardiac sarcoidosis. *Circulation - Cardiovascular Imaging*. 2018;11(1): e007030. Available at: http://circimaging.ahajournals.org/content/11/1/e007030.

Wang A, Gaca JG, Chu VH. Management consideration in infective endocarditis: A review. *NEJM*. 2018;320(1):72-83.

Wolk MJ, Bailey SR, Doherty JU, et al. ACCF/AHA/ASE/ASNC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2013 Multimodality appropriate use criteria for the detection and risk assessment of stable ischemic heart disease: A report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2014; 63(4):380-406. Available at: http://content.onlinejacc.org/article.aspx?articleid=1789799

Yancy C, Jessup M, Bozkurt B, et al. 2013 ACCF/AHA Guideline for the management of heart failure: A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2013; 62(16):e147-237.

Reviewed / Approved by NIA Clinical Guideline Committee

1. Gulati M, Levy PD, Mukherjee D, et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Cardiovasc Comput Tomogr*. Dec 01 2021;doi:10.1016/j.jcct.2021.11.009
2. Patel MR, Calhoon JH, Dehmer GJ, et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. May 2 2017;69(17):2212-2241. doi:10.1016/j.jacc.2017.02.001
3. Wolk MJ, Bailey SR, Doherty JU, et al. ACCF/AHA/ASE/ASNC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2013 multimodality appropriate use criteria for the detection and risk assessment of stable ischemic heart disease: a report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for

Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. Feb 4 2014;63(4):380-406. doi:10.1016/j.jacc.2013.11.009
4. Budoff MJ, Raggi P, Beller GA, et al. Noninvasive Cardiovascular Risk Assessment of the Asymptomatic Diabetic Patient: The Imaging Council of the American College of Cardiology. *JACC Cardiovasc Imaging*. Feb 2016;9(2):176-92. doi:10.1016/j.jcmg.2015.11.011
5. Aguilar-Salinas CA, Rojas R, Gomez-Perez FJ, et al. Analysis of the agreement between the World Health Organization criteria and the National Cholesterol Education Program-III definition of the metabolic syndrome: results from a population-based survey. *Diabetes Care*. May 2003;26(5):1635.
6. Fihn SD, Gardin JM, Abrams J, et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS guideline for the diagnosis and management of patients with stable ischemic heart disease: a report of the American College of Cardiology Foundation/American Heart Association task force on practice guidelines, and the American College of Physicians, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *Circulation*. Dec 18 2012;126(25):e354-471. doi:10.1161/CIR.0b013e318277d6a0
7. Patel MR, White RD, Abbara S, et al. 2013 ACCF/ACR/ASE/ASNC/SCCT/SCMR appropriate utilization of cardiovascular imaging in heart failure: a joint report of the American College of Radiology Appropriateness Criteria Committee and the American College of Cardiology Foundation Appropriate Use Criteria Task Force. *J Am Coll Cardiol*. May 28 2013;61(21):2207-31. doi:10.1016/j.jacc.2013.02.005
8. Yancy CW, Jessup M, Bozkurt B, et al. 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. Oct 15 2013;62(16):e147-239. doi:10.1016/j.jacc.2013.05.019
9. Tsai JP, Yun CH, Wu TH, et al. A meta-analysis comparing SPECT with PET for the assessment of myocardial viability in patients with coronary artery disease. *Nucl Med Commun*. Sep 2014;35(9):947-54. doi:10.1097/mnm.0000000000000140
10. Al-Khatib SM, Stevenson WG, Ackerman MJ, et al. 2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. *J Am Coll Cardiol*. Oct 2 2018;72(14):e91-e220. doi:10.1016/j.jacc.2017.10.054
11. Reiffel JA, Camm AJ, Belardinelli L, et al. The HARMONY Trial: Combined Ranolazine and Dronedarone in the Management of Paroxysmal Atrial Fibrillation: Mechanistic and Therapeutic Synergism. *Circ Arrhythm Electrophysiol*. Oct 2015;8(5):1048-56. doi:10.1161/circep.115.002856
12. Anagnostopoulos C, Harbinson M, Kelion A, et al. Procedure guidelines for radionuclide myocardial perfusion imaging. *Heart*. 2004;90 Suppl 1(Suppl 1):i1-i10. doi:10.1136/heart.90.suppl_1.i1
13. Gräni C, Buechel RR, Kaufmann PA, Kwong RY. Multimodality Imaging in Individuals With Anomalous Coronary Arteries. *JACC Cardiovasc Imaging*. Apr 2017;10(4):471-481. doi:10.1016/j.jcmg.2017.02.004

14. Tang K, Wang L, Shi R, et al. The role of myocardial perfusion imaging in evaluating patients with myocardial bridging. *J Nucl Cardiol*. Feb 2011;18(1):117-22. doi:10.1007/s12350-010-9303-6
15. McCrindle BW, Rowley AH, Newburger JW, et al. Diagnosis, Treatment, and Long-Term Management of Kawasaki Disease: A Scientific Statement for Health Professionals From the American Heart Association. *Circulation*. Apr 25 2017;135(17):e927-e999. doi:10.1161/cir.0000000000000484
16. Lancellotti P, Nkomo VT, Badano LP, et al. Expert consensus for multi-modality imaging evaluation of cardiovascular complications of radiotherapy in adults: a report from the European Association of Cardiovascular Imaging and the American Society of Echocardiography. *Eur Heart J Cardiovasc Imaging*. Aug 2013;14(8):721-40. doi:10.1093/ehjci/jet123
17. Birnie DH, Nery PB, Ha AC, Beanlands RS. Cardiac Sarcoidosis. *J Am Coll Cardiol*. Jul 26 2016;68(4):411-21. doi:10.1016/j.jacc.2016.03.605
18. Blankstein R, Waller AH. Evaluation of Known or Suspected Cardiac Sarcoidosis. *Circ Cardiovasc Imaging*. Mar 2016;9(3):e000867. doi:10.1161/circimaging.113.000867
19. Vita T, Okada DR, Veillet-Chowdhury M, et al. Complementary Value of Cardiac Magnetic Resonance Imaging and Positron Emission Tomography/Computed Tomography in the Assessment of Cardiac Sarcoidosis. *Circ Cardiovasc Imaging*. Jan 2018;11(1):e007030. doi:10.1161/circimaging.117.007030
20. Doherty JU, Kort S, Mehran R, Schoenhagen P, Soman P. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2017 Appropriate Use Criteria for Multimodality Imaging in Valvular Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. Sep 26 2017;70(13):1647-1672. doi:10.1016/j.jacc.2017.07.732
21. Habib G, Lancellotti P, Antunes MJ, et al. 2015 ESC Guidelines for the management of infective endocarditis: The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM). *Eur Heart J*. Nov 21 2015;36(44):3075-3128. doi:10.1093/eurheartj/ehv319
22. Wang A, Gaca JG, Chu VH. Management Considerations in Infective Endocarditis: A Review. *Jama*. Jul 3 2018;320(1):72-83. doi:10.1001/jama.2018.7596
23. Bhave NM, Nienaber CA, Clough RE, Eagle KA. Multimodality Imaging of Thoracic Aortic Diseases in Adults. *JACC Cardiovasc Imaging*. Jun 2018;11(6):902-919. doi:10.1016/j.jcmg.2018.03.009
24. Kristensen SD, Knuuti J, Saraste A, et al. 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management: The Joint Task Force on non-cardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA). *Eur Heart J*. Sep 14 2014;35(35):2383-431. doi:10.1093/eurheartj/ehu282

25. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines. *J Am Coll Cardiol*. Dec 09 2014;64(22):e77-137. doi:10.1016/j.jacc.2014.07.944
26. Velasco A, Reyes E, Hage FG. Guidelines in review: Comparison of the 2014 ACC/AHA guidelines on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery and the 2014 ESC/ESA guidelines on noncardiac surgery: Cardiovascular assessment and management. *J Nucl Cardiol*. 02 2017;24(1):165-170. doi:10.1007/s12350-016-0643-8
27. Lentine KL, Costa SP, Weir MR, et al. Cardiac disease evaluation and management among kidney and liver transplantation candidates: a scientific statement from the American Heart Association and the American College of Cardiology Foundation. *J Am Coll Cardiol*. Jul 31 2012;60(5):434-80. doi:10.1016/j.jacc.2012.05.008
28. Mc Ardle BA, Dowsley TF, deKemp RA, Wells GA, Beanlands RS. Does rubidium-82 PET have superior accuracy to SPECT perfusion imaging for the diagnosis of obstructive coronary disease?: A systematic review and meta-analysis. *J Am Coll Cardiol*. Oct 30 2012;60(18):1828-37. doi:10.1016/j.jacc.2012.07.038
29. Bateman TM, Dilsizian V, Beanlands RS, DePuey EG, Heller GV, Wolinsky DA. American Society of Nuclear Cardiology and Society of Nuclear Medicine and Molecular Imaging Joint Position Statement on the Clinical Indications for Myocardial Perfusion PET. *J Nucl Med*. Oct 2016;57(10):1654-1656. doi:10.2967/jnumed.116.180448
30. Fazel R, Dilsizian V, Einstein AJ, Ficaro EP, Henzlova M, Shaw LJ. Strategies for defining an optimal risk-benefit ratio for stress myocardial perfusion SPECT. *J Nucl Cardiol*. May 2011;18(3):385-92. doi:10.1007/s12350-011-9353-4
31. Montalescot G, Sechtem U, Achenbach S, et al. 2013 ESC guidelines on the management of stable coronary artery disease: the Task Force on the management of stable coronary artery disease of the European Society of Cardiology. *Eur Heart J*. Oct 2013;34(38):2949-3003. doi:10.1093/eurheartj/eht296
32. Shen WK, Sheldon RS, Benditt DG, et al. 2017 ACC/AHA/HRS Guideline for the Evaluation and Management of Patients With Syncope: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. *J Am Coll Cardiol*. Aug 1 2017;70(5):620-663. doi:10.1016/j.jacc.2017.03.002
33. Mark DB, Hlatky MA, Harrell FE, Jr., Lee KL, Califf RM, Pryor DB. Exercise treadmill score for predicting prognosis in coronary artery disease. *Ann Intern Med*. Jun 1987;106(6):793-800. doi:10.7326/0003-4819-106-6-793
34. D'Agostino RB, Sr., Vasan RS, Pencina MJ, et al. General cardiovascular risk profile for use in primary care: the Framingham Heart Study. *Circulation*. Feb 12 2008;117(6):743-53. doi:10.1161/circulationaha.107.699579
35. Goff DC, Jr., Lloyd-Jones DM, Bennett G, et al. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. Jul 1 2014;63(25 Pt B):2935-2959. doi:10.1016/j.jacc.2013.11.005

36. McClelland RL, Jorgensen NW, Budoff M, et al. 10-Year Coronary Heart Disease Risk Prediction Using Coronary Artery Calcium and Traditional Risk Factors: Derivation in the MESA (Multi-Ethnic Study of Atherosclerosis) With Validation in the HNR (Heinz Nixdorf Recall) Study and the DHS (Dallas Heart Study). *J Am Coll Cardiol*. Oct 13 2015;66(15):1643-53. doi:10.1016/j.jacc.2015.08.035
37. Ridker PM, Buring JE, Rifai N, Cook NR. Development and validation of improved algorithms for the assessment of global cardiovascular risk in women: the Reynolds Risk Score. *Jama*. Feb 14 2007;297(6):611-9. doi:10.1001/jama.297.6.611
38. Patel MR, Bailey SR, Bonow RO, et al. ACCF/SCAI/AATS/AHA/ASE/ASNC/HFSA/HRS/SCCM/SCCT/SCMR/STS 2012 appropriate use criteria for diagnostic catheterization: a report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, Society for Cardiovascular Angiography and Interventions, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society of Critical Care Medicine, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, Society of Thoracic Surgeons. *J Thorac Cardiovasc Surg*. Jul 2012;144(1):39-71. doi:10.1016/j.jtcvs.2012.04.013
39. Lotfi A, Davies JE, Fearon WF, Grines CL, Kern MJ, Klein LW. Focused update of expert consensus statement: Use of invasive assessments of coronary physiology and structure: A position statement of the society of cardiac angiography and interventions. *Catheter Cardiovasc Interv*. Aug 1 2018;92(2):336-347. doi:10.1002/ccd.27672

ADDITIONAL RESOURCES

1. Hendel RC, Berman DS, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging: A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the American Society of Nuclear Cardiology, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the Society of Cardiovascular Computed Tomography, the Society for Cardiovascular Magnetic Resonance, and the Society of Nuclear Medicine. *J Am Coll Cardiol*. Jun 9 2009;53(23):2201-29. doi:10.1016/j.jacc.2009.02.013
2. Hirshfeld JW, Jr., Ferrari VA, Bengel FM, et al. 2018 ACC/HRS/NASCI/SCAI/SCCT Expert Consensus Document on Optimal Use of Ionizing Radiation in Cardiovascular Imaging-Best Practices for Safety and Effectiveness, Part 1: Radiation Physics and Radiation Biology: A Report of the American College of Cardiology Task Force on Expert Consensus Decision Pathways Developed in Collaboration With Mended Hearts. *Catheter Cardiovasc Interv.* Aug 1 2018;92(2):203-221. doi:10.1002/ccd.27660
3. Osborne MT, Hulten EA, Singh A, et al. Reduction in ^{18}F-fluorodeoxyglucose uptake on serial cardiac positron emission tomography is associated with improved left ventricular ejection fraction in patients with cardiac sarcoidosis. *J Nucl Cardiol*. Feb 2014;21(1):166-74. doi:10.1007/s12350-013-9828-6

4. Parker MW, Iskandar A, Limone B, et al. Diagnostic accuracy of cardiac positron emission tomography versus single photon emission computed tomography for coronary artery disease: a bivariate meta-analysis. *Circ Cardiovasc Imaging*. Nov 2012;5(6):700-7. doi:10.1161/circimaging.112.978270
5. Patel MR, Bailey SR, Bonow RO, et al. ACCF/SCAI/AATS/AHA/ASE/ASNC/HFSA/HRS/SCCM/SCCT/SCMR/STS 2012 appropriate use criteria for diagnostic catheterization: a report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, Society for Cardiovascular Angiography and Interventions, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society of Critical Care Medicine, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. May 29 2012;59(22):1995-2027. doi:10.1016/j.jacc.2012.03.003
6. Patel MR, Calhoon JH, Dehmer GJ, et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. May 2 2017;69(17):2212-2241. doi:10.1016/j.jacc.2017.02.001
7. Rahbar K, Seifarth H, Schäfers M, et al. Differentiation of malignant and benign cardiac tumors using 18F-FDG PET/CT. *J Nucl Med*. Jun 2012;53(6):856-63. doi:10.2967/jnumed.111.095364
8. Salaun E, Habib G. Beyond Standard Echocardiography in Infective Endocarditis: Computed Tomography, 3-Dimensional Imaging, and Multi-Imaging. *Circ Cardiovasc Imaging*. Mar 2018;11(3):e007626. doi:10.1161/circimaging.118.007626
9. Schindler TH, Schelbert HR, Quercioli A, Dilsizian V. Cardiac PET imaging for the detection and monitoring of coronary artery disease and microvascular health. *JACC Cardiovasc Imaging*. Jun 2010;3(6):623-40. doi:10.1016/j.jcmg.2010.04.007

Reviewed / Approved by NIA Clinical Guideline Committee

Disclaimer: Magellan Healthcare service authorization policies do not constitute medical advice and are not intended to govern or otherwise influence the practice of medicine. These policies are not meant to supplant your normal procedures, evaluation, diagnosis, treatment and/or care plans for your patients. Your professional judgement must be exercised and followed in all respects with regard to the treatment and care of your patients. These policies apply to all Magellan Healthcare subsidiaries including, but not limited to, National Imaging Associates ("Magellan"). The policies constitute only the reimbursement and coverage guidelines of Magellan. Coverage for services varies for individual members in accordance with the terms and conditions of applicable Certificates of Coverage, Summary Plan Descriptions, or contracts with governing regulatory agencies. Magellan reserves the right to review and update the guidelines at its sole discretion. Notice of such changes, if necessary, shall be provided in accordance with the terms and conditions of provider agreements and any applicable laws or regulations.