ASNC MODEL COVERAGE POLICY

Single Photon Myocardial Perfusion Imaging

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Endorsed by the American College of Cardiology, the American College of Radiology and the Society of Nuclear Medicine.

Introduction

Description of Policy

This document is intended as a model coverage policy for SPECT myocardial perfusion imaging studies and delineates under what clinical indications such a study is appropriate to administer to patients. This document examines a variety of clinical indications and symptoms that a common patient would present with and supports the use of performing such a study by cross-referencing the indication with the multi-society appropriate use criteria for radionuclide studies developed by the American College of Cardiology (ACC)/ASNC in 2005, and subsequently revised in 2009.[1] In addition, the use of SPECT MPI in patients with the indications delineated in the policy is supported by references to an abundance of literature which supports the use of this study in the provided scenarios. Finally, we have provided the ICD-9 codes which correlate to each of the indications to demonstrate what codes, or ranges of codes, are appropriate for each clinical indication.

Purpose of Policy

The purpose and intent of this policy is to streamline the process by which payers reimburse for SPECT MPI procedures. It is our hope that by providing this list of clinical indications where a use of MPI is supported by our expert panel of reviewing cardiologists as well as our multi-society appropriate use criteria, and numerous literary references which demonstrate the value of the study in a given scenario; that payers will accept and adopt this model coverage policy as their own and use it as a guide for reimbursing MPI studies. The hope is that this policy will serve as both an educational tool to ASNC members and the cardiology community as a whole, regarding both the appropriate use of SPECT MPI studies as well as demonstrate the correct ICD-9 codes for those clinical indications. We also believe this policy will serve as a literature-

based guide for payers on how these clinical indications and ICD-9 codes crosswalk to the SPECT MPI Appropriate Use Criteria.

Policy Disclaimers

While ASNC strongly believes this model coverage policy for SPECT MPI is an excellent guide for clinicians and payers alike, it should not be used as a comprehensive tool. We fully expect that as technologies and best practices in our medical field change and evolve, so too will this model coverage policy. In addition, ASNC believes clinical decision-making regarding the appropriate application of SPECT MPI for a given patient should remain solely with the physician treating the patient and should be first and foremost, based on the ACC/ASNC Appropriate Use Criteria. It is our position that in all cases where patients present with indications that fall under either the "A" (appropriate) or "U" (uncertain) categories of the Appropriate Use Criteria, these studies should be universally covered and reimbursed by Medicare contractors and private payers. Typically, only studies which fall into the "I" (inappropriate) category should be denied reimbursement.[1] There may, however, be situations where a study appears to fall into the "I" category initially, but upon further review or a peer-to-peer discussion with the insurer or their RBM about the provider's rationale for performing the study, it becomes apparent that the study is not inappropriate and should in fact be covered by the insurer. In addition, we acknowledge that the information provided in this document is focused on the typical patient's clinical indications and there will always be patients who present with indications or symptoms not captured within this model coverage policy. In those cases, it is our expectation that providers will adhere to literature-based guidelines and provide the payer with as much clinical information as possible to support the use of performing a SPECT MPI study in an atypical patient.

Revision History

The ASNC Model Coverage Policy for Myocardial Perfusion Imaging was originally developed in 2005 and was revised in 2011. The impetus for revision of this model coverage policy is a result of a variety of coding and utilization modifications which have taken place over the past few years and directly impact the practice of nuclear cardiology. In 2010, CPT implemented new packaged/bundled codes. These new bundled codes are represented by CPT codes 78451-78454. In addition, the multi-medical specialty society Appropriate Use Criteria for Cardiac Radionuclide Imaging, which was published in 2005, was recently revised in 2009.[1] Therefore, we felt it essential to update the policy to reflect modifications to the Appropriate Use Criteria, which are based on expert-clinical judgment and expertise. In addition, ICD 9 codes are also updated annually and any change from those annual updates are included in this revised policy.

AMA CPT / ADA CDT

CMS National

Title XVIII of the Social Security Act, Section 1862(a)(1)(A). This section allows coverage and payment for only those services that are considered to be medically reasonable and necessary.
Title XVIII of the Social Security Act, Section 1833(e). This section prohibits Medicare payment for any claim, which lacks the necessary information to process the claim.

§4317(b), of the Balanced Budget Act (BBA), specifies that referring physicians are required to provide diagnostic information to the testing entity at the time the test is ordered.

42 Code of Federal Regulations (CFR) §410.32 and §410.33, indicates that diagnostic tests are payable only when ordered by the physician who is treating the beneficiary for a specific medical problem and who uses the results in such treatment.

CMS Publication 100-04, Medicare Claims Processing Manual Chapter 4
-200.8 - Billing for Nuclear Medicine Procedures

CMS Publication 100-04, Medicare Claims Processing Manual Chapter 12
-20.4.4 - Supplies

CMS Publication 100-04, Medicare Claims Processing Manual Chapter 13
-20 - Payment Conditions for Radiology Services
-50 - Nuclear Medicine

CMS Publication 100-02, Medicare Benefit Policy Manual Chapter 15
-60 - Services and Supplies
-60.1 - Incident To Physician's Professional Services
-80 - Requirements for Diagnostic X-Ray, Diagnostic Laboratory, and Other Diagnostic Tests
-80.6 - Requirements for Ordering and Following Orders for Diagnostic Tests

Indications and Limitations of Coverage and/or Medical Necessity

Myocardial perfusion imaging (MPI) is a technique in which radionuclide tracers (predominantly thallium-201 and technetium 99m-based agents) are used to evaluate myocardial blood flow, as well as myocardial scarring or infarction, in order to diagnose and assess the significance of coronary artery disease (CAD). When administered intravenously, these radionuclides distribute in proportion to the regional myocardial blood flow present at the time of injection. MPI may be performed at rest, or more commonly, in conjunction with cardiac stress using exercise and/or pharmacologic stimulation (adenosine, regadenoson, dipyridamole or dobutamine). Technetium 99m-based tracers are usually administered twice, once at rest, and again following cardiac stress. Thallium-201 is usually administered following cardiac stress, with a booster dose sometimes being given prior to rest imaging. The tracer distribution in the heart is then imaged using a gamma camera, yielding scintigrams which depict the myocardial distribution of coronary blood flow. Typically, the scintigrams are compared qualitatively and/or quantitatively to recognized normal patterns. Perfusion abnormalities, or defects, are assessed and quantified as to location, extent and severity, often allowing localization to specific coronary artery territories. Perfusion defects present with cardiac stress and absent at rest are termed "reversible", and are suggestive of myocardial ischemia, and hemodynamically significant coronary stenoses. Defects

present on both rest and stress imaging are consistent with myocardial scarring or infarction. MPI is most often performed using tomographic techniques and reconstruction algorithms utilizing either filtered back projection or repeating iterations and smoothing (SPECT imaging---single photon emission computerized tomography, CPT 78451, 78452). Planar (non-tomographic) technique CPT 78453, 78454) is occasionally utilized in certain clinical circumstances that interfere with optimal quality SPECT imaging, such as orthopedic shoulder problems. MPI is typically performed using ECG-synchronized gating of the post-stress and resting images. This allows qualitative evaluation of left and right ventricular size and function as well as calculation of LV ejection fraction. Alternatively, first-pass imaging of the intravenous technetium 99m bolus through the heart may be performed to evaluate left and right ventricular function and ejection fractions. The use of wall motion analysis has been shown to improve the accuracy of MPI for diagnosing coronary disease by simplifying the identification of attenuation artifacts. In addition, either technique of wall motion study, with calculation of LV ejection fraction, provides definitive information on ventricular function, which is one of the strongest predictors of prognosis.

In a variety of situations, MPI may also be performed at rest, without accompanying cardiac stress. In patients with known or suspected myocardial infarction rest MPI is effective at determining the severity of myocardial scarring and quantifying ventricular function. Qualitative and quantitative analysis of resting MPI scintigrams allows assessment of myocardial viability and the likelihood that ventricular function can be restored by coronary revascularization. The presence of viable myocardium is a critical parameter in predicting whether a patient will benefit from angioplasty/stent procedures or bypass surgery. Rest imaging may also be indicated to assess the likelihood of cardiac etiology of ongoing chest pain, such as in patients presenting to the emergency department with such symptoms.

Extensive clinical evidence has documented the utility of myocardial perfusion imaging in the evaluation of patients with known or suspected heart disease.

MPI provides important information pertaining to three critical aspects of cardiac diagnosis and management:

1) Diagnosis: In patients suspected of having coronary disease because of chest discomfort, dyspnea, arrhythmias, cardiac risk factors or other clinical findings, stress MPI is a highly sensitive and specific test for identifying CAD. In patients presenting to the emergency department with acute chest pain, rest MPI is effective in diagnosing an acute coronary syndrome.

2) Prognosis: In patients with known or suspected CAD, the extent of myocardial ischemia, infarction, and viability determined by MPI correlate well with prognosis. MPI allows separation of CAD patients into subgroups with low, intermediate, and high risk for cardiac events, thus helping to guide medical and interventional management.

3) Response to Therapy: In patients with known CAD and prior coronary revascularization, MPI provides important information regarding the adequacy of revascularization. In patients

with known CAD on medical therapy, MPI can evaluate the ability of the patient's medical regimen at reducing myocardial ischemia.

SPECIFIC INDICATIONS

The accepted specific indications for MPI are grouped according to the purpose of the study relative to the three general categories delineated above.

The evaluation of patients with suspected CAD has traditionally employed exercise ECG stress testing (ETT) as the primary modality, and reserved MPI for secondary diagnostic use. However, it is now increasingly recognized that ETT may yield frequent false positive results (particularly in women) or false negatives (in patients at significant risk for CAD). This may lead to uncertainty, patient anxiety, and delays in or failure to make appropriate diagnosis. Since the published accuracy of MPI is superior to ETT, many physicians now use MPI as their primary test for CAD. MPI guided therapy has been shown to be cost effective in the management of patients presenting with presumptive coronary artery disease.[2] Large retrospective studies demonstrate that outcome with medical versus revascularization therapy is proportional to ischemic burden.[3] Consequently, either strategy should be considered appropriate.

Table 1. Indications for MPI for Diagnostic Purposes

Applicable ICD-9 code*	**Appropriate Clinical Indications for Conducting an MPI**	**Literature supporting MPI study**	**Appropriate Use Criteria which Supports Conducting MPI study**
413.9, 414.8-414.9, 786.05-786.09, 786.50-786.59	As the initial test for symptomatic patients at increased risk for CAD, defined as having risk for hard cardiac events (cardiovascular death or non-fatal myocardial infarction).	1) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ ASNC /ACR /AHA /ASE /SCCT /SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229.	AUC indication(s) 2, 3, and 4.
446.1, 446.7, 746.8-746.89	Patients who have non-atherosclerotic coronary artery disease, including coronary anomalies.	1) Donaldson RM, Raphael M, Radley-Smith R, Yacoub MH, Ross DN. Angiographic identification of primary coronary anomalies causing impaired myocardial perfusion. Catheterization and Cardiovascular Diagnosis. 1983; 9(3):237-49. 2) Miyagawa M, Mochizuki T, Murase K, et al. Prognostic value of dipyridamole-thallium myocardial scintigraphy in patients with Kawasaki disease. Circulation. 1998; (10):990-6. 3) Cimarelli S, Imperiale A, Ben-Sellem D, et. al. Nuclear Medicine Imaging of Takotsubo Cardiomyopathy: Typical form and midventricular ballooning syndrome. J Nucl Cardiol 2008; 15: 137-	AUC indication(s) 2

		141. 4) Ito K, Sugihara H, Kinoshita N. Assessment of Takutsubo Cardiomyopathy using Tc 99m tetrofosmin, I-123 BMIPP, I-123 MIBG, and Tc 99m PYP myocardial SPECT. Annals of Nuclear Medicine 2005; 19: 435-445. 5) De Luca L, Bovenzi F, Rubini D, et. al. Stress-Rest myocardial perfusion SPECT for functional assessment of coronary arteries with anomalous origin or course. J Nucl Med 2004; 45:532-536. 6) Davis JA, Cecchin F, Jones TK, Port MA. Major coronary artery anomalies in a pediatric population: incidence and clinical importance. J Am Coll Cardiol 2001; 37:593-7. 7) Katsuragi M, Yamamoto K, Tashiro T, Nishihara H, Toudou K. Tallium-201 myocardial SPECT in Bland-White-Garland Syndrome: Two patients with infero-posterior perfusion defects. J Nucl Med 1993; 34:2182-2184. 8) Elhendy A, Stieneke Z, Cornel JH, Fioretti PM, Bogers, et. al. Functional assessment of ALCAPA Syndrome by dobutamine stress thallium-201 SPECT and echocardiography. J Nucl Med 1996; 37: 748-751. 9) Brothers JA, McBride MG, Seliem MA, Marino BS, Tomlinson RS et. al. Evaluation of myocardial ischemia afer surgical repair of anomalous aortic origin of a coronary artery in a series of pediatric patients. J Am Coll Cardiol 2007; 50: 2078-82. 10) Chen ML, Lo HS, Chao IM, Su HY. Dipyridamole thallium-201 myocardial single photon emission computed tomography in the functional assessment of anomalous left coronary artery from the pulmonary artery. Clin Nuc Med 2007; 32:940-943.	
780.02, 786.05 - 786.09, 786.50-786.59, 413.9.	As the initial test in patients with diabetes mellitus, with or without symptoms of suspected angina or coronary disease.	1) Giri S, Shaw LJ, Murthy DR et al. Impact of diabetes on the risk stratification using stress single-photon emission computed tomography myocardial perfusion imaging in patients with symptoms suggestive of coronary artery disease. Circulation. 2002; 105: 32-40. 2) Wiersma JJ, Verberne HJ, Ten Holt WL, et al.	AUC indication(s) 3, 4, 5.

		Prognostic value of myocardial perfusion scintigraphy in myocardial perfusion scintigraphy in type 2 diabetic patients with mild, stable angina pectoris. J Nucl Card 2009; 16:524-32.	
426.1, 426.2, 426.10 - 426.93.	Patients with suspected coronary disease in whom an abnormal baseline ECG interferes with interpretation of exercise-induced ST segment deviations (some examples of which are LVH, digoxin, therapy, or nonspecific ST and T-wave abnormalities on resting ECG).	1) Elhendy A, van Domburg RT, Sozzi FB et. Al. Impact of Hypertension on the Accuracy of Exercise stress myocardial perfusion imaging for the diagnosis of coronary artery disease. Heart 2001; 85:655-661. 2) Amanullah A, Berman DS, Kang X et. al. Enhanced prognostic stratification of patients with left ventricular hypertrophy with the use of single photon emission computerized tomography. Am Heart J 2000; 140:456-462. 3) Vaduganathan P, He ZX, Mahmarian JL, Verani MS. Diagnostic Accuracy of stress thallium-201 tomography in patients with left ventricular hypertrophy. Am J Cardiol 1998; 81:1205- 1217.	AUC indication(s) 2, 4, 6, 7, 8, 11, and 14.
794.30, 794.31	Patients with an abnormal exercise stress ECG without angina symptoms, to further determine whether CAD is present.	1) Fleg JL, Gerstenblith G, Zonderman AB, Becker LC, Weisfeldt ML, Costa PT Jr, Lakatta EG. Prevalence and prognostic significance of exercise-induced silent myocardial ischemia detected by thallium scintigraphy and electrocardiography in asymptomatic volunteers. Circulation. 1990; 81:428-36. 2) Travin MI, Flores AR, Boucher CA, Newell JB, LaRaia PJ. Silent versus symptomatic ischemia during a thallium-201 exercise test. Am J Cardiol 1991; 68:1600- 8. 3) Ladenheim ML, Kotler TS, Pollock BH, Berman DS, Diamond GA. Incremental prognostic power of clinical history, exercise electrocardiography and myocardial perfusion scintigraphy in suspected coronary artery disease. Am J Cardiol 1987; 59: 270- 277. 4) Hachamovitch r, Berman DS, Kiat H, Cohen I, Cabico JA, Friedman J, Diamond GA. Exercise Myocardial Perfusion SPECT in Patients Without Known Coronary Artery Disease. Incremental Prognostic Value and Use in Risk Stratification Circulation 1996; 93: 905- 914. 5) Gibbons RJ, Hodge DO, Berman DS, Akinboboye OO, Heo J, Hachamovitch R, Bailey KR, Iskandrian. Long-term outcome of patients with intermediate-risk exercise electrocardiograms who do not have myocardial perfusion defects on	AUC indication(s)s 3, 5, 29 and 30.

		radionuclide imaging. Circulation 1999; 100: 2140-2145.	
786.5, 414.01, 414.8	Patients with an intermediate to high Duke treadmill score.	1) Gibbons RJ, Hodge DO, Berman DS, et al. Long-term outcome of patients with intermediate-risk exercise electrocardiograms who do not have myocardial perfusion defects on radionuclide imaging. Circulation 1999; 100: 2140-5. 2) Hachamovitch R, Berman DS, Kiat H, et al. Exercise myocardial perfusion SPECT in patients without known coronary artery disease: incremental prognostic value and use in risk stratification, Circulation 1996; 93:905-14. 3) 2003 ACC/ASNC/AHA Guidelines for Clinical Use of Radionuclide Imaging, J. Am Coll Card 2003; 42:1318, 1323.	AUC indication(s) 38 and 39.
414.0, 411, V71.7.	All patients who are asymptomatic, or have low to intermediate probability of coronary artery disease; but have an occupation that places other individuals at risk if they suffer a coronary event.	1) Blair RE. Coronary Artery Disease in a Young USAF Pilot: Screening for Premature Atherosclerosis. Military Medicine 2010; 175(9): 688-690. 2) Houston S, Mitchell S, Evans S. Application of a Cardiovascular Disease Risk Prediction Model Among Commercial Pilots. Aviat Space Environ Med 2010; 81:768-773. 3) 2003 ACC/ASNC/AHA Guidelines for Clinical Use of Radionuclide Imaging, J. Am Coll Card 2003; 42:1318.	AUC does not address this clinical scenario but testing is supported by ACC/ASNC/AHA Guidelines.
426.20-50	Patients with intra-ventricular conduction delay who require pharmacologic stress MPI with coronary vasodilators to determine the presence and extent of coronary disease.	1) Cerqueira M. Imaging Techniques in Nuclear Cardiology. In: Topol EJ, Califf RM, Prystowsky EN, Thomas JD, Thompson PD, eds. Textbook on Cardiovascular Imaging. 3rd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2007:884 - 896. 2) De Lorenzo A, Hachamovitch R, Kang X, et al; Prognostic Value of Myocardial perfusion SPECT versus exercise electrocardiography in patients with ST-segment depression on resting electrocardiography. J Nucl Cardiol 2005; 12:655-61. 3) Wagdy HM, Hodge D, Christian TF, et al. Prognostic value of vasodilator myocardial perfusion imaging in patients with left bundle-branch block. Circulation 1998; 97: 1563–1570. 4) Gioia G, Bagheri B, Gottlieb CD, et al. Prediction of outcome of patients with life-threatening ventricular arrhythmias treated with automatic implantable cardioverter-defibrillators	AUC indication(s) 2, 3, and 4.

		using SPECT perfusion imaging. Circulation1997; 95:390–394.	
719.7, 781.2, 443.9, 440.21, 278.00, 278.01, along with the applicable chest pain codes 786.50 - 786.59.	Patients who have suspected CAD and who have a condition which would prevent them from achieving a diagnostically adequate level of cardiac stimulation (85% predicted maximum heart rate) on standard exercise ECG stress testing. ** These patients are candidates for pharmacologic stress testing, with or without low level exercise.	1) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ ASNC /ACR /AHA /ASE /SCCT /SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229. 2) Iskandrian, AS, Heo J, Kong B, Lyons E. Effect of exercise level on the ability of thallium-201 tomographic imaging in detecting CAD(analysis of 461 patients).J Am Coll. Cardiol.1989;14:1477-1486. 3) Hlatky MA , Pryor DB , Harrel FE , Califf RM , Mark DB , Rosati RA . Factors affecting sensitivity and specificity of exercise electrocardiography (multivariable analysis). Am J Med . 1984; 77:64–71. 4) Gianrossi R, Detrano R, Mulvihill D, Lehmann K, Dubach P, Colombo A, et al. Exercise-induced ST depression in the diagnosis of CAD (a meta-analysis) . Circulation . 1989; 80:87–98. 5) Fletcher GF, Balady GJ, Amsterdam EA, Chaitman B, Eckel R, Fleg J, et al Exercise standards for testing and training (a statement for healthcare professionals from the American Heart Association) . Circulation . 2001;10:1694–1740	AUC indication(s) 2, 4, and 5.
412, 414.8-414.90, 425-425.9, 429, 429.83, 428.00-428.90	Patients with a cardiomyopathy in whom MPI is performed to differentiate between coronary disease and other non-ischemic cardiomyopathy.	1) Danias PG, Ahlberg AW, Clark BA 3rd, Messineo F, et. al. Combined assessment of myocardial perfusion and left ventricular function with exercise technetium-99m sestamibi gated single-photon emission computed tomography can differentiate between ischemic and non-ischemic dilated cardiomyopathy. Am J Cardiol 1998; 82(10):1253-8. 2) Danias PG, Papaioannou GI, Ahlberg AW, O'Sullivan DM, et.al. Usefulness of electrocardiographic-gated stress technetium-99m sestamibi single-photon emission computed tomography to differentiate ischemic from non-ischemic cardiomyopathy. Am J Cardiol 2004; 94(1):14-9. 3) Glamann DB, Lange RA, Corbett JR, Hillis LD. Utility of various radionuclide techniques for distinguishing ischemic from non-ischemic dilated cardiomyopathy. Arch Intern Med. 1992; 152:769–	AUC indication(s) 62.

		72. 1992. 4) Chikamori T, Doi YL, Yonezawa Y, et al. Value of dipyridamole thallium-201 imaging in noninvasive differentiation of idiopathic dilated cardiomyopathy from coronary artery disease with left ventricular dysfunction. Am J Cardiol. 1992; 69:650–53. 5) Mody FV, Brunken RC, Stevenson LW, et al. Differentiating cardiomyopathy of coronary artery disease from non-ischemic dilated cardiomyopathy utilizing positron emission tomography. J Am Coll Cardiol. 1991; 17:373–83. 6) Eisenberg JD, Sobel BE, Geltman EM. Differentiation of ischemic from non-ischemic cardiomyopathy with positron emission tomography. Am J Cardiol. 1987; 59:1410–14. 7) Hunt SA, Baker DW, Goldstein S, et.al. ACC/AHA Guidelines for the Evaluation and Management of Chronic Heart Failure in Adults. Circulation. 2001; 104:2996.	
419.2, 793.2, 794.30	Patients with a ventricular wall motion abnormality demonstrated by another imaging modality, in which MPI is performed to determine whether coronary disease is the etiology.	1) Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. J Nucl Cardiol 2011; 18(1):3-15. 2) Soman P, Lahiri A, Mieres JH, Calnon DA, Wolinsky D, et al. Etiology and pathophysiology of the new-onset heart failure: Evaluation by myocardial perfusion imaging. J Nucl Cardiol. 2009; 16(1):82-91.	AUC indication(s) 16.
425.10, 425.0-425.9, 413.9, 786.5, 411, 786.05 - 786.09, 780.02	Patients with hypertrophic cardiomyopathy in whom MPI is performed to differentiate coronary versus non-coronary causes of chest discomfort.	1) Dilsizian V, Panza JA, Bonow RO. Myocardial perfusion imaging in hypertrophic cardiomyopathy. JACC Cardiovasc Imaging. 2010; 3(10):1078-80. 2) Sorajja P, Chareonthaitawee P, Ommen SR, Miller TD, Hodge DO, Gibbons RJ. Prognostic utility of single-photon emission computed tomography in adult patients with hypertrophic cardiomyopathy. Am Heart J. 2006; 151(2):426-35. 3) O'Gara PT, Bonow RO, Maron BJ, Damske BA, Van Lingen A, Bacharach SL, Larson SM, Epstein SE. Myocardial perfusion abnormalities in patients with hypertrophic cardiomyopathy: assessment with thallium-201 emission computed tomography. Circulation. 1987; 76(6):1214-23.	AUC indication(s) 2, 4, and 29.
395.2-395.90	Patients with valvular heart disease in whom MPI is	Van Tosh A. The value of myocardial perfusion imaging for diagnosing coronary artery disease in	AUC indication(s) 2, 3 and 4.

	performed to differentiate coronary vs. non-coronary causes of chest discomfort.	patients with aortic valve stenosis. Adv Cardiol. 2002; 39:61-9.	
996.83, V42.1	Patients with cardiac transplantation in whom MPI is performed to evaluate the presence of obstructive CAD.	1) Manrique A, Bernard M, Hitzel A, Bubenheim M, Tron C, Agostini D, Redonnet M. Diagnostic and prognostic value of myocardial perfusion gated SPECT in orthotopic heart transplant recipients. J Nucl Cardiol 2010; 17 (2) 197-206. 2) Accompanying Editorial: Soman P, McNamara D. Surveillance for post-transplant coronary artery vasculopathy: Shifting gears from diagnosis to prognosis. J Nucl Cardiol 2010; 17(2): 172-174. 3) Ciliberto GR, Ruffini L, Mangiavacchi M, et. al. Resting echocardiography and quantitative dipridamole technetium 99m sestamibi tomography in the identificaiotn of cardiac allograft vasculopathy and the prediction of long term prognosis after heart transplantation. Eur Heart J 2001; 22:964-71. 4) Rodney RA, Johnson LL, Blood DK, Barr ML. Myocardial perfusion scintigraphy in heart transplant recipients with and without allograft atherosclerosis: A comparison of thallium-201 and technetium 99m sestamibi. J Heart Lung Transplant 1994; 13:173-80. 5) Howarth DM, Forstrom LA, Sanmudrala V. Evaluation of Tl-201 SPECT myocardial perfusion imaging in the detection of coronary artery disease after orthotopic heart transplantation. Nucl Med Commun 1996; 17:105-113. 6) Elhendy A, Sozzi FB, Van Domburg RT, et. Al. Accuracy of dobutamine tetrofosmin myocardial perfusion imaging for the noninvasive diagnosis of transplant coronary artery stenosis. J Heat Lung Transplant 2000; 19: 360-66. 7) Hacker M, Tausig A, Romuller B, et. al. Dobutamine myocardial scintigraphy for the prediction of cardiac eents after heart transplantation. Nucl Med Commun 2005; 26: 607-12.	AUC indication(s) 15.
V72.80-72.84	Patients with suspected or known coronary disease being evaluated for cardiovascular risk prior to non-cardiac surgery, who meet the recommendations for MPI set forth in the clinical guidelines	1) Kertai MD, Boersma E, Bax JJ, Heijenbrok-Kal MH, et. al. A meta-analysis comparing the prognostic accuracy of six diagnostic tests for predicting peri-operative cardiac risk in patients undergoing major vascular surgery. Heart 2003; 89:1327-34. 2) Best PJ, Tajik AJ, Gibbons RJ, Pellikka PA. The	AUC indication(s) 43 and 47.

	of the American Society of Nuclear Cardiology and the American College of Cardiology.	safety of treadmill exercise stress testing in patients with abdominal aortic aneurysms. Ann Intern Med 1998; 129:628-31. 3) Mangano DT, Goldman L. Preoperative assessment of patients with known or suspected coronary disease. N Engl J Med 1995; 333:1750. 4) Etchells E, Meade M, Tomlinson G, Cook D. Semi-quantitative dipyridamole myocardial stress perfusion imaging for cardiac risk assessment before non-cardiac vascular surgery: a meta-analysis. J. Vasc Surg. 2002; 36:534-40. 5) Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. J Nucl Cardiol 2011; 18(1):3-15. 6) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229.	
427.31, 427.32, 427.1	Patients with atrial or ventricular cardiac arrhythmias, to determine the presence and functional severity of potential coronary disease and to determine the safety of anti-arrhythmic medications.	1) Abidov A, Hackamovitch R, Rozanski A, et al. Prognostic implications of atrial fibrillation in patients undergoing myocardial perfusion single-photon emission computed tomography. J Am Coll Cardiol 2004; 44: 1062–70. 2) Askew JW, Miller T, Hodge DO, Gibbons RJ. The value of myocardial perfusion single-photon emission computed tomography in screening asymptomatic patients with atrial fibrillation for coronary artery disease. J Am Coll Cardiol 2007; 50: 1080-85. 3) Fuster V, Ryden LE, Cannom DS, et al. ACC/AHA/ESC 2006 Practice Guidelines for the management of patients with atrial fibrillation. J Am Coll Cardiol 2006; 48: 854-906. 4) Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. J Nucl Cardiol 2011; 18(1):3-15.	AUC indication(s) 18 and 19.
780.2	Patients at intermediate or high risk of coronary artery disease with syncope or pre-syncope, to determine the presence and functional	1) Georgeson S, Linzer M, Griffith JL, et al. Acute cardiac ischemia in patients with syncope: Importance of the initial electrocardiogram. J Gen Intern Med. 1992; 7: 379-86. 2) Hendel RC, Berman DS, MD, Di Carli MF, et al.	AUC indication(s) 21.

	severity of potential coronary disease.	ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009.	
413.9, 786.50-786.59, 786.05-786.09	Patients presenting to the emergency department with acute chest pain, to evaluate the possibility of an acute coronary syndrome.	1) Wackers FJ, Brown KA, Heller GV, et al. ASNC position statement on radionuclide imaging in patients with suspected acute ischemic syndromes in the emergency department or chest pain center. J Nucl Cardiol 2002; 9:246-50. 2) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229.	AUC indication(s) 6, 7, 8, and 9, and 11.

*Note: ICD-9 codes must be coded to the highest level of specificity.

Table 2. Indications for MPI for Prognostic Purposes

Applicable ICD-9 code*	**Appropriate Clinical Indications for Conducting an MPI**	**Literature supporting MPI study**	**Appropriate Use Criteria which Supports Conducting MPI study**
413, 414.0 – 414.07, 414.8-414.9, 429.2	Patients with high probability of CHD based on clinical findings and risk factors who are having MPI to define the extent and severity of CAD for prognostic purposes. Selected asymptomatic high risk subgroups may also be candidates for MPI; these include, but are not limited to: high risk diabetics, patients with chronic kidney disease, and patients with strong family history of CAD.	1) Hendel RC, Abbott BG, Bateman TM, et al. ASNC Information Statement: The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. J Nucl Cardiol. 2010; 1071-3581. 2) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229. 3) Greenland P, Alpert JS, Beller GA, Benjamin EJ, Budoff MJ, Fayad ZA, Foster E, Hlatky MA, Hodgson JM, Kushner FG, Lauer MS, Shaw LJ, Smith SC Jr, Taylor AJ, Weintraub WS, Wenger NK, Jacobs AK, Smith SC Jr, Anderson JL, Albert N, Buller CE, Creager MA, Ettinger SM, Guyton RA, Halperin JL, Hochman JS, Kushner FG, Nishimura R, Ohman EM, Page RL, Stevenson WG, Tarkington LG, Yancy CW; American College of Cardiology Foundation; American Heart Association. 2010 ACCF/AHA guideline for assessment of cardiovascular risk in asymptomatic adults: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2010 Dec 14;	AUC indication(s) 15.

		56(25):2182-99., J Am Coll Cardiol 2010 Dec 14; 56(25):e50-103. 4) Ladenheim ML, Pollock BH, Rozanski A, et al. Extent and severity of myocardial hypo-perfusion as predictors of prognosis in patients with suspected coronary artery disease. J Am Coll Cardiol. 1986; 7:464-71. 5) Diaz L, Brunken RC, Blackstone EH, et al. Independent contribution of myocardial perfusion defects to exercise capacity and heart rate recovery for prediction of all-cause mortality in patients with known or suspected coronary heart disease. J Am Coll Cardiol. 2001; 37:1558-64. 6) Hachamovitch R, Berman DS, Kiat H, et al. Exercise myocardial perfusion SPECT in patients without known coronary artery disease: incremental prognostic value and use in risk stratification. , Circulation 1996; 93:905-14. 7) Hachamovitch R, Berman DS, Shaw LJ, et al. Incremental prognostic value of myocardial perfusion single photo emission computed tomography for the prediction of cardiac death: Differential stratification for risk of cardiac death and myocardial infarction. Circulation 1998; 97:535-43. 8) Hachamovitch R, Hayes SW, et al. Comparison of the short-term survival benefit associated with revascularization compared with medical therapy in patients with no prior coronary artery disease undergoing stress myocardial perfusion single photon emission computed tomography. Circulation. 2003; 107:2900-07. 9) 2003 ACC/ASNC/AHA Guidelines for Clinical Use of Radionuclide Imaging, J. Am Coll Card 2003; 42:1318 pages 1320-3, 1326.	
414.0, 413.9, 414.8, 786.09, 786.50.	Patients with an abnormal standard stress test who are having MPI to determine the extent of ischemia to guide future therapy.	1) Klocke FJ, Baird MG, Bateman TM, Berman DS, Carabello BA, Cerqueira MD, et.al. ACC/AHA/ASNC Guidelines for the clinical use of cardiac radionuclide imaging. Circulation 2003. 2) Hachamovitch R, Hayes S, Friedman JD, Cohen I, Shaw LJ, Germano G, Berman DS. Determinants of risk and its temporal variation in patients with normal stress myocardial perfusion scans: what is the warranty period of a normal stress myocardial perfusion scan: J Am Coll Cardiol 2003; 41 1329 - 1340. 3) Hachamovitch R, Di Carli MF. Contemporary reviews in cardiovascular medicine: Methods and limitations of assessing new noninvasive tests. Outcomes-based validation and reliability assessment of noninvasive	AUC indication(s) 29 and 30.

		testing Circulation 2008; 117: 2792-2802. 4) Hachamovitch R, Berman DS, Kiat H, Cohen I, Friedman JD, Shaw LJ. Value of stress myocardial perfusion single photon emission computed tomography in patients with normal resting electrocardiograms: an evaluation of incremental prognostic value and cost-effectiveness. Circulation 2002; 105:823-829. 5) Hachamovitch R, Hayes S, Friedman j, Cohen i, Berman DS. Stress myocardial perfusion SPECT is clinically effective and cost effective in risk stratification of patients with a high likelihood of CAD but no known CAD. J Am Coll Cardiol 2004; 43:200-208. 6) Hachamovitch R, Berman DS, Kiat H, Cabico JA, Friedman J, Diamond GA. Exercise myocardial perfusion SPECT in patients without known coronary artery disease: incremental prognostic value and use in risk stratification. Circulation 1996; 93:904-914.	
411.0,412, 413.9, 786.50, 786.51, 786.59, 786.05	Patients with known CAD who have new onset of angina, angina equivalents, or significant change in symptoms.	1) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229.	AUC indication(s) 4 and 5.
414.0-414.07, 411, 410-410.92, 428.0 - 428.90	Patients with a history of CAD and recent myocardial infarction in whom MPI is performed to define the presence of post-MI ischemia, myocardium at risk, assess myocardial viability, and assess LV function (using gated MPI techniques).	1) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229.	AUC indication(s) 50, 52, 56, and 62.
786.50 - 786.59, 414.0-414.07, 411.	Patients with acute coronary syndromes who have become stable on medical therapy and are undergoing MPI to assess ischemic burden on medical therapy, and whether or not angiography and revascularization are indicated.	1) Madsen JK, Stubgaard M, Utne HE, Hansen JF, van Duijvendijk K, Reiber JH, Christoffersen K. Prognosis and thallium-201 scintigraphy in patients admitted with chest pain without confirmed acute myocardial infarction. Br Heart J. 1988; 59(2):184-9. 2) Zhu YY, Chung WS, Botvinick EH, Dae MW, Lim AD, Ports TA, Danforth JW, Wolfe CL, Goldschlager N, Chatterjee K. Dipyridamole perfusion scintigraphy: the experience with its application in one hundred seventy patients with known or suspected unstable angina. Am Heart J. 1991; 121(1 Pt 1):33-43. 3) Younis LT, Byers S, Shaw L, Barth G, Goodgold H,	AUC indication(s) 50 and 51.

		Chaitman BR. Prognostic value of intravenous dipyridamole thallium scintigraphy after an acute myocardial ischemic event. Am J Cardiol. 1989; 64(3):161-6. 4) Stratmann HG, Younis LT, Wittry MD, Amato M, Miller DD. Exercise technetium-99m myocardial tomography for the risk stratification of men with medically treated unstable angina pectoris. Am J Cardiol. 1995; 76(4):236-40. 5) Stratmann HG, Tamesis BR, Younis LT, Wittry MD, Amato M, Miller DD. Prognostic value of pre-discharge dipyridamole technetium 99m sestamibi myocardial tomography in medically treated patients with unstable angina. Am Heart J. 1995; 130(4):734-40. 6) Brown KA, Heller GV, Landin RS, Shaw LJ, Beller GA, Pasquale MJ, Haber SB. Early dipyridamole (99m)Tc-sestamibi single photon emission computed tomographic imaging 2 to 4 days after acute myocardial infarction predicts in-hospital and post discharge cardiac events: comparison with submaximal exercise imaging. Circulation. 1999; 100(20):2060-6. 7) Mahmarian JJ, Shaw LJ, Filipchuk, NG, Dakik, HA. A Multinational Study to Establish the Value of Early Adenosin Technetium-99M Sestamibi Myocardial Perfusion Imaging in Indentifing a Low Risk Group for Early Hospital Discharge after Acutue Myocardial Infarction. JACC 2006; 48(12):2448-57. 8) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229.	
786.05-09	Patients with poor functional capacity which is felt to be an independent marker of coronary risk to assess for presence of significant coronary artery disease.	Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. J Nucl Cardiol 2011; 18(1):3-15.	AUC criterion(s) 2, 3, 4, and 5.
410-410.92, 411, 412, 413.9, 414.0-414.07, 414.8-	Risk assessment of patients with test results and/or known chronic stable CAD. (3 subgroups listed below).	1) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229. 2) Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for	AUC indication(s) 58, > 5 years post-CABG; AUC indication(s)

414.90, 429.10, 786.05-786.09, 786.50-786.59, 794.30		asymptomatic individuals. J Nucl Cardiol 2011; 18(1):3-15. 3) Sharir T, Germano G, Kavanagh PB, Lai S, Cohen I, Lewin HC, Friedman JD, Zellweger MJ, Berman DS. Incremental prognostic value of post-stress left ventricular ejection fraction and volume by gated myocardial perfusion single photon emission computed tomography. Circulation 1999 Sep 7; 100(10):1035-42. 4) Mathur S, Shah AR, Ahlberg AW, Katten DM, Heller GV. Blunted heart rate response as a predictor of cardiac death in patients undergoing vasodilator stress technetium-99m sestamibi gated SPECT myocardial perfusion imaging. J Nucl Cardiol 2010 Aug; 17(4):617-24. 5) Navare SM, Mather JF, Shaw LJ, Fowler MS, Heller GV. Comparison of risk stratification with pharmacologic and exercise stress myocardial perfusion imaging: a meta-analysis. J Nucl Cardiol 2004 Sep-Oct; 11(5):551-61.	57, < 5 years post-CABG; AUC indication(s) 60, > 2 years post PCI.
410-410.92, 411, 412, 413.9, 414.0-414.07, 414.8-414.90, 429.10, 786.05-786.09, 786.50-786.59, 794.30	Subgroup 1: Patients two or more years removed from an abnormal index SPECT MPI study.	1) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229. 2) Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. J Nucl Cardiol 2011; 18(1):3-15. 3) Sharir T, Germano G, Kavanagh PB, Lai S, Cohen I, Lewin HC, Friedman JD, Zellweger MJ, Berman DS. Incremental prognostic value of post-stress left ventricular ejection fraction and volume by gated myocardial perfusion single photon emission computed tomography. Circulation 1999 Sep 7; 100(10):1035-42. 4) Mathur S, Shah AR, Ahlberg AW, Katten DM, Heller GV. Blunted heart rate response as a predictor of cardiac death in patients undergoing vasodilator stress technetium-99m sestamibi gated SPECT myocardial perfusion imaging. J Nucl Cardiol 2010 Aug; 17(4):617-24. 5) Navare SM, Mather JF, Shaw LJ, Fowler MS, Heller GV. Comparison of risk stratification with pharmacologic and exercise stress myocardial perfusion imaging: a meta-analysis. J Nucl Cardiol 2004 Sep-Oct; 11(5):551-61.	AUC indication(s) 58.
410-410.92, 411, 412,	Subgroup 2: Patients two or more years removed from a PCI.	1) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide	AUC indication(s) 57.

413.9, 414.0-414.07, 414.8-414.90, 429.10, 786.05-786.09, 786.50-786.59, 794.30		Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229. 2) Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. J Nucl Cardiol 2011; 18(1):3-15. 3) Sharir T, Germano G, Kavanagh PB, Lai S, Cohen I, Lewin HC, Friedman JD, Zellweger MJ, Berman DS. Incremental prognostic value of post-stress left ventricular ejection fraction and volume by gated myocardial perfusion single photon emission computed tomography. Circulation 1999 Sep 7; 100(10):1035-42. 4) Mathur S, Shah AR, Ahlberg AW, Katten DM, Heller GV. Blunted heart rate response as a predictor of cardiac death in patients undergoing vasodilator stress technetium-99m sestamibi gated SPECT myocardial perfusion imaging. J Nucl Cardiol 2010 Aug; 17(4):617-24. 5) Navare SM, Mather JF, Shaw LJ, Fowler MS, Heller GV. Comparison of risk stratification with pharmacologic and exercise stress myocardial perfusion imaging: a meta-analysis. J Nucl Cardiol 2004 Sep-Oct; 11(5):551-61.	
410-410.92, 411, 412, 413.9, 414.0-414.07, 414.8-414.90, 429.10, 786.05-786.09, 786.50-786.59, 794.30	Subgroup 3: Patients five or more years removed from coronary bypass surgery.	1) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229. 2) Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. J Nucl Cardiol 2011; 18(1):3-15. 3) Sharir T, Germano G, Kavanagh PB, Lai S, Cohen I, Lewin HC, Friedman JD, Zellweger MJ, Berman DS. Incremental prognostic value of post-stress left ventricular ejection fraction and volume by gated myocardial perfusion single photon emission computed tomography. Circulation 1999 Sep 7; 100(10):1035-42. 4) Mathur S, Shah AR, Ahlberg AW, Katten DM, Heller GV. Blunted heart rate response as a predictor of cardiac death in patients undergoing vasodilator stress technetium-99m sestamibi gated SPECT myocardial perfusion imaging. J Nucl Cardiol 2010 Aug; 17(4):617-24. 5) Navare SM, Mather JF, Shaw LJ, Fowler MS, Heller GV. Comparison of risk stratification with pharmacologic and exercise stress myocardial perfusion imaging: a meta-	AUC indication(s) 60.

		analysis. J Nucl Cardiol 2004 Sep-Oct; 11(5):551-61.	
410-410.92, 412.	Patients with known coronary disease and left ventricular dysfunction who are having MPI to identify the presence of myocardial viability, and determine suitability for revascularization procedures.	1) Hunt SA, Abraham Wy, Chin MH, Feldman AM et al. 2009 Focused Update incorporated into the ACC/AHA 2005 Guidelines for the Diagnosis and Management of Heart failure in adults: A report of the ACC Foundation/ AHA Task force on the practice guidelines developed in collaboration with the International Society for Heart and Lung transplantation. JACC 2009; 53: e1-90. 2) Allman KC, Shaw LJ, Hachamovitch R et al. Myocardial viability testing and impact of revascularization on prognosis in patients with coronary artery disease and left ventricular dysfunction: A meta-analysis. JSCC 2002; 39:1151-58. 3) Camic, Prasad SJ, Rimoldi OE. Stunning, hibernation and the assessment of myocardial viability. Circulation 2008; 117:103-114.	AUC indication(s) 1, 3, and 62.
746.8 - 746.89, 429.2, 414.8-414.90, 414.0-414.07	To define functional severity of known CAD by prior testing such as coronary angiography or coronary CTA.	Donaldson RM, Raphael M, Radley-Smith R, Yacoub MH, Ross DN. Angiographic identification of primary coronary anomalies causing impaired myocardial perfusion. Catheterization and Cardiovascular Diagnosis. 1983; 9(3):237-49.	AUC indication(s) 32.
414.01	Patients who have coronary calcification on CT scan which is quantified by an Agastaton score greater than, or equal to, 100.	1) Rozanski A, Gransar H, Wong ND, et al. Clinical outcomes after both coronary calcium scanning and exercise myocardial perfusion scintigraphy. J Am Coll Cardiol 2007; 49:1352-61. 2) 2003 ACC/ASNC/AHA Guidelines for Clinical Use of Radionuclide Imaging, J. Am Coll Card 2003; 42:1318 pages 1324-5.	AUC scores of 35, 36.
250.00-250.9, 410.0-410.9 414.0.	As the initial test in patients with diabetes mellitus, without symptoms of suspected angina or coronary disease.	1) Bax,JJ, Bonow RO, Tscgope D, et al. Global dialogue group for the evaluation of cardiovascular risk in patients with diabetes: The potential of myocardial perfusion scintigraphy for risk stratification of asymptomatic patients with type 2 diabetes. JACC 2006;48: 754-60. 2) Wackers FJT, Younf LH, Inzucchi SE, et al. Detection of silent myocardial ischemia in asymptomatic diabetic subjects. The DIAD study. Diabetes Care 2004; 27: 1954-61. 3) Rajagopolan N, Miller TD, Hodge DO, Frye RL, Gibbons RJ. Identifying high-risk asymptomatic diabetic patients who are candidates for screening stress single-photon emission computed tomography imaging. JACC 2005; 2005:43-49.	AUC indication(s) 14, 15.

		4) Scholte AJ, Bax JJ, Wackers FJ. Screening of asymptomatic patients with type 2 diabetes mellitus for silent coronary artery disease: Combined use of stress myocardial perfusion imaging and coronary calcium scoring. J Nucl card 2006; 13:11-18. 5) American Diabetes Assn. Standards of medical care in diabetes-2010. Diabetes Care 2010; 33:S11-61.	
403- 404.9	Chronic Kidney Disease	1) Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. J Nucl Cardiol 2011; 18(1):3-15. 2) Go AS, Chertow GM, Fan D, McCulloch CE, Hsu CY. Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization. N Engl J Med 2204; 351:1296-1305. 3) Tonelli M, Wiebe N, Culleton B, et al.Chronic Kidney disease and mortality risk: A systematic review. J Am Soc Nephrol 2006; 17: 2034-2047. 4) Okwuosa T, Williams KA. Coronary artery disease and nuclear imaging in renal failure. J Nucl Cardiol 2006; 13:150-155. 5) Brown JH, Vites NP, Testa HJ, et al. Value of thallium myocardial imaging in the prediction of future cardiovascular events in patients with end-stage renal failure. Nephrol Dial Transplant 1993; 8: 433-437. 6) Weiner DE, Tighiouart H, Amin MG, et al. Chronic kidney disease as a risk factor for cardiovascular disease and all-cause mortality: a pooled analysis of community-based studies J Am Soc Nephrol 2004;15:1307-1315. 7) Meisinger C, Doring A, Lowel H, KORA Study Group Chronic kidney disease and risk of incident myocardial infarction and all-cause and cardiovascular disease mortality in middle-aged men and women from the general population Eur Heart J 2006;27:1245-1250. 8) Manjunath G, Tighiouart H, Ibrahim H, et al. Level of kidney function as a risk factor for atherosclerotic cardiovascular outcomes in the community J Am Coll Cardiol 2003;41:47-55. 9) Muntner P, He J, Hamm L, Loria C, Whelton PK. Renal insufficiency and subsequent death resulting from cardiovascular disease in the United States J Am Soc Nephrol 2002;13:745-753	AUC indication(s) 15.

*Note: ICD-9 codes must be coded to the highest level of specificity.

Table 3. Indications for MPI to Evaluate the Effectiveness of Medical Therapy or Revascularization

Applicable ICD-9 code*	Appropriate Clinical Indications for Conducting an MPI	Literature supporting MPI study	Appropriate Use Criteria which Supports Conducting MPI study
414.0-414.07, 414.8-414.90	MPI to assess the efficacy of medical therapy for reduction of inducible myocardial ischemia.	1) Rourke RA, Chaudhurt T, Shaw L, et al. Resolution of stress-induced myocardial ischemia during aggressive medical therapy as demonstrated by single photon emission computed tomography imaging. Circulation 2001; 103: 2315. 2) Ronald G. Schwartz, Thomas A. Pearson, Vijay G. Kalaria, Maria L. Mackin, Daniel J. Williford, Ashish Awasthi, Abrar Shah, Adam Rains, Joseph J. Guido. Prospective serial evaluation of myocardial perfusion the first six months of pravastatin therapy. J Am Coll Cardiol 2003; 42: 600-610. 3) Gould KL, Martucci JP, Goldberg DI, Hess MJ, Edens RP, Latifi R, et al. Short-term cholesterol lowering decreases size and severity of perfusion abnormalities by positron emission tomography after dipyridamole in patients with coronary artery disease. A potential noninvasive marker of healing coronary endothelium. Circulation 1994; 89:1530-8. 4) Leslee J. Shaw, Daniel S. Berman, David J. Maron, G.B. John Mancini, Sean W. Hayes, Pamela M. Hartigan, William S. Weintraub, Robert A. Oâ Rourek, Macin Dada, John A. Spertus, Bernard R. Chaitman, John Friedman, Piotr Slomka, Gary V. Heller, Guido Germano, Gilbert Gosselin, Perter Berge, William J. Kostuk, Ronald G. Schwartz, Merill Knudtson, Emir Veledar, Eric R. Bates, Benjamin McCallister, Koon K. Teo, William E. Boden, for the COURAGE Investigators. Optimal medical therapy with or without percutaneous coronary intervention to reduce ischemic burden. Results From the Clinical Outcomes Utilizing Revascularization and Aggressive Drug Evaluation (COURAGE) Trial Nuclear Sub-study. Circulation 2008; 117: 1283-	AUC indication(s) 28.

		1291.	
413.9, 786.5, 411, 786.05-786.09, 780.02, 414.0-414.07, 414.8-414.90, V45.81, V45.82.	MPI following coronary revascularization in patients with recurrent angina-like symptoms	1) Klocke FJ, Bard MG, Bateman TM, Berman DS, et. al. Guidelines for the Clinical Use of cardiac radionuclide imaging. Circulation 2003; 108:1404-1418.	AUC indication(s) 55.
413.9, 786.5, 411, 786.05-786.09, 780.02, 414.0-414.07, 414.8-414.90, V45.81, V45.82.	MPI following coronary revascularization in asymptomatic patients deemed at high risk for restenosis, or who have had incomplete revascularization, or who have high risk coronary anatomy.	1) Klocke FJ, Bard MG, Bateman TM, Berman DS, et. al. Guidelines for the Clinical Use of cardiac radionuclide imaging. Circulation 2003; 108:1404-1418. 2) Gibbons R, Balady G, Bricker J, et. al. ACC/AHA 2002 guideline update for exercise testing. Circulation 2002; 106: 1883. 3) Georgoulias, P, Demakopoulos N, Kontos A, et al. Tc 99m tetrofosmin myocardial perfusion imaging before and six months after percutaenous transluminal coronary angioplasty. Clin Nucl Med. 1998; 23: 678-82. 4) Zellweger M, Weinbacher M, Zutter A, et al. Long-term outcome of patients with silent verses symptomatic ischemia six months after percutaneous coronary intervention and stenting. J Am Coll Cardiol 2003; 42:33-40. 5) Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J. Am. Coll. Cardiol. 2009; 53; 2201-2229.	AUC indication(s) 56.

*Note: ICD-9 codes must be coded to the highest level of specificity.

Coding Guidelines

ICD–9 Codes

ICD-9 codes must be coded to the highest level of specificity. For a complete list of medically necessary ICD-9 codes **see Table 4**. All ICD-9 codes not in Table 4 will be denied.

CPT/HCPCS Section & Benefit Category

Radiology
Drugs other than oral
Medical and surgical supplies
Medicine

Bill Type Codes For Hospital Use

Contractors may specify Bill Types to help providers identify those Bill Types typically used to report this service. Absence of a Bill Type does not guarantee that the policy does not apply to that Bill Type. Complete absence of all Bill Types indicates that coverage is not influenced by Bill Type and the policy should be assumed to apply equally to all claims.

Revenue Codes for Hospital Use

Contractors may specify Revenue Codes to help providers identify those Revenue Codes typically used to report this service. In most instances Revenue Codes are purely advisory; unless specified in the policy services reported under other Revenue Codes are equally subject to this coverage determination. Complete absence of all Revenue Codes indicates that coverage is not influenced by Revenue Code and the policy should be assumed to apply equally to all Revenue Codes.

0340 Nuclear medicine-general classification
0341 Nuclear medicine-diagnostic procedure
0343 Nuclear medicine-diagnostic radiopharmaceutical
0636 Drugs requiring detailed coding

> **Usage notes:** (a) Charges for drugs and biological (with the exception of radiopharmaceuticals, which are reported under Revenue Codes 0343 and 0344) requiring specific identifications as required by the payer (effective 10/1/04). If HCPCs are used to describe the drug, enter the HCPCS code in Form Locator 44. The specified units of service to be reported are to be in hundreds (100s) rounded to the nearest hundred (no decimal).

0960 Professional Fees – General Classification
0969 Professional Fees – Other Professional Fee
0982 Professional fees – Outpatient Services

CPT/HCPCS Codes

78451 Myocardial perfusion imaging, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic).

78452 Myocardial perfusion imaging, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or rest reinjection.

78453 Myocardial perfusion imaging, planar (including qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic.

78454 Myocardial perfusion imaging, planar (including qualitative or quantitative all motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or rest reinjection.

A9500 Technetium; Tc-99M, Sestamibi, Diagnostic, per study dose.

A9502 Technetium; Tc-99M, Tetrofosmin, Diagnostic, per study dose.

A9505 Thallium; TL-201, Thallous Chloride, Diagnostic, per millicurie.
(**Note:** typically an initial dose of 2-4 mCi is given at peak exercise, and imaging is performed immediately, and then 4-6 hours later after redistribution.)

General Information

- When performing both the rest and stress portions of the myocardial perfusion imaging for any one of the covered indications, a multiple study procedure code (78452, 78454) should be billed regardless of whether the imaging occurs on the same day or two different days.

- There are three types of studies as defined by the myocardial perfusion code descriptions, a rest study, a stress study, and a redistribution study. The rest and stress studies are each considered a "single" study for billing purposes. Any combination of two or more of these studies is considered a "multiple" study for billing purposes. Providers choose the appropriate CPT code based on the number of studies performed.

- Injection procedures are considered inherent to myocardial perfusion imaging studies. The edits in CMS's current correct coding initiative list all the administration codes as component codes for CPT 78451-78454 and therefore

they are not additionally reportable. This is true for most nuclear medicine imaging procedures.

- The HCPCS Level II codes describe the radiopharmaceuticals used for myocardial perfusion studies. If Thallium 201 is used, bill for the total number of mCi injected for the study. If a Tc99m myocardial perfusion agent is used, bill for the number of doses administered, as follows: if a single rest or stress study is done, bill one unit; if both a rest and a stress study are done, bill two units. Please note that HCPCS does not describe the quantity of a Tc99m myocardial perfusion agent by mCi, but by "per study dose" regardless of the actual administered injected radioactive dose for each imaging study.

- When medically necessary, cardiovascular stress testing can be performed in conjunction with nuclear medicine procedures. To review related policies, please refer to the Cardiovascular Stress Testing CPT codes 93015-93018.

Table 4. ICD-9 Codes that Support Medical Necessity

Clinical Indication	**Applicable ICD-9 Code***
Diabetes Mellitis	250.00-250.93
Overweight and Obesity	278.00 - 278.01
Rheumatic aortic stenosis	395.2-395.90
Mitral valve and aortic valve diseases	396.0-396.9
Hypertension; benign	401.1
Hypertensive chronic kidney disease	403 - 403.9
Hypertensive heart and chronic kidney disease	404.0-404.9
Acute Myocardial Infarction	410-410.92
Other acute and subacute forms of ischemic heart disease	411
Old Myocardial Infarction	412
Angina pectoris; other and unspecified angina pectoris	413.9
Myocardial bridging	414.0
Coronary Atherosclerosis	414.0-414.07
Aneurysm and dissection of heart	414.1-414.19
Aneurysm - Chronic total occlusion of coronary artery	414.2
Chronic Ischemic Heart Disease	414.8-414.90
Cardiomyopathy	425.0-425.9
Hypertrophic Obstructive Cardiomyopathy	425.10
Conduction disorders; Atrioventricular block	426.10-426.93
Conduction Disorders; Bundle Branch Block	426.20-426.50
Conduction Disorder; Unspecified	426.90
Cardiac Dysrhythmias	427.00
Paroxysmal ventricular tachycardia	427.10
Paroxysmal tachycardia	427.20
Atrial Fibrillation	427.31
Atrial Flutter	427.32
Cardiac Arrest	427.50
Arrhythmias	427.0-427.89
Heart Failure	428.00-428.90

Myocarditis; unspecified	429
Myocardial degeneration	429.10
Cardiovascular Disease; Unspecified	429.2
Functional disturbances following cardiac surgery	429.40
Takotsubo syndrome	429.83
Carotid artery	433.1
Atherosclerosis of the extremities with intermittent claudication	440.21
Aortic aneurysm and dissection	441.0-441.9
Other aneurysm	442
Peripheral Vascular Disease	443.0-443.9
Kawasaki Disease	446.1
Takayasu's disease	446.7
Chronic Kidney Disease	585.1 - 585.9
Anomalous Coronary Artery	746.8 - 746.89
Symptoms	
Difficulty in walking	719.7
General symptoms; alteration of consciousness; transient alteration of awareness	780.02
Syncope and collapse	780.2
Symptoms involving nervous and musculoskeletal systems - abnormality of gate	781.2
Palpatations	785.1
Symptoms involving respiratory system and other chest symptoms	786.05-786.09
Chest Pain	786.50-786.59
Nonspecific (abnormal) findings on radiological and other examination of body structure; Other intrathoracic organ	793.2
Abnormal Cardiovascular Study	794.30
Abnormal ECG	794.31
Adverse Reaction to Medications / Anesthesia	995.20-995.29
Complications with Heart Valve Surgery	996.71-996.72
Complications with Heart Transplant	996.83
Heart Transplant	V42.1
Family History Ischemic Heart Disease	V17.3 / V17.41 / V17.49
Heart Valve Surgery	V42.2 / V43.3
Postprocedural status; aortocoronary bypass status	V45.81
Percutaneous transluminal coronary angioplasty status	V45.82
Long Term (current) drug use of other medications	V58.69
Observation for suspected Cardiovascular Disease	V71.7
Preoperative Cardiovascular Evaluation	V72.80-72.84
Erectile Dysfunction; with inhibited sexual excitement	302.72

***** Note: ICD-9 codes must be coded to the highest level of specificity.

References

[1] Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. J Am Coll Cardiol 2009;53;2201-2229.

[2] Des Prez RD, Shaw LJ, Gillespie RL, et al. ASNC Information Statement: Cost-effectiveness of myocardial perfusion imaging: A summary of the currently available literature. J Nucl Cardiol 2005;12:750-9.

[3] Hachamovitch R, Hayes SW, Friedman JD, Cohen I, and Berman DS. Comparison of the short-term survival benefit associated with revascularization compared with medical therapy in patients with no prior coronary artery disease undergoing stress myocardial perfusion single photon emission computed tomography. Circulation 2003;107:2900-07.