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POLICY

The use of computed tomography to detect coronary artery calcification is considered investigational.

POLICY GUIDELINES

When quantitative assessment is performed as part of the same encounter as contrast-enhanced cardiac computed tomography (codes 75572-75573) or coronary computed tomography angiography (code 75574), it is included in the service.

The primary fast computed tomography methods for this determination are electron beam computed tomography and multidetector computed tomography.

BENEFIT APPLICATION

BLUECARD/NATIONAL ACCOUNT ISSUES

State or federal mandates (eg, Federal Employee Program) may dictate that certain U.S. Food and Drug Administration–approved devices, drugs, or biologics may not be considered investigational, and thus these devices may be assessed only by their medical necessity.

Coverage eligibility of computed tomography scanning to detect coronary artery calcium may be limited by contractual exclusions for screening tests.

BACKGROUND

CORONARY ARTERY CALCIUM

Coronary artery calcium (CAC) is associated with coronary artery disease (CAD) based anatomic studies. The development of fast computed tomography (CT) scanners has allowed the measurement of CAC in
Computed Tomography to Detect Coronary Artery Calcification

Clinical practice. CAC has been evaluated in several clinical settings. The most widely studied indication is for the use of CAC in the prediction of future risk of CAD in patients with the subclinical disease, with the goal of instituting appropriate risk-reducing therapy (e.g., statin treatment, lifestyle modifications) to improve outcomes. Also, CAC has been evaluated in patients with symptoms potentially consistent with CAD, but in whom a diagnosis is unclear.

Detection
Electron-beam computed tomography (EBCT; also known as ultrafast CT) and spiral CT (or helical CT) may be used as an alternative to conventional CT scanning due to faster throughput. In both methods, the speed of image acquisition gives them unique value for imaging a moving heart. The rapid image acquisition time virtually eliminates motion artifact related to cardiac contraction, permitting visualization of the calcium in the epicardial coronary arteries. EBCT software permits quantification of calcium area and density, which are translated into calcium scores. Calcium scores have been investigated as a technique for detecting CAC, both as a diagnostic technique in symptomatic patients to rule out an atherosclerotic etiology of symptoms or, in asymptomatic patients, as an adjunctive method for risk stratification for CAD.

EBCT and multidetector CT were initially the primary fast CT methods for measurement of CAC. A fast CT study for CAC measurement takes 10 to 15 minutes and requires only a few seconds of scanning time. More recently, computed tomography angiography has been used to assess coronary calcium. Because of the basic similarity between EBCT and computed tomography angiography in measuring coronary calcium, it is expected that computed tomography angiography provides information on coronary calcium that is similar to EBCT.

CT scan–derived coronary calcium measures have been used to evaluate coronary atherosclerosis. Coronary calcium is present in coronary atherosclerosis, but the atherosclerosis detected may or may not be causing ischemia or symptoms. Coronary calcium measures may be correlated with the presence of critical coronary stenoses or serve as a measure of the patient’s proclivity toward atherosclerosis and future coronary disease. Thus, coronary calcium could serve as a variable to be used in a risk assessment calculation to determine appropriate preventive treatment in asymptomatic patients. Alternatively, in other clinical scenarios, coronary calcium scores might help determine whether there is an atherosclerotic etiology or component to the presenting clinical problem in symptomatic patients, thus helping to direct further workup for the clinical problem. In this second scenario, a calcium score of 0 usually indicates that the patient’s clinical problem is unlikely to be due to atherosclerosis and that other etiologies should be more strongly considered. In neither case does the test determine a specific diagnosis. Most clinical studies have examined the use of coronary calcium for its potential use in estimating the risk of future coronary heart disease events.

Nomenclature
Coronary calcium levels can be expressed in many ways. The most common method is the Agatston score, which is a weighted summed total of calcified coronary artery area observed on CT. This value can be expressed as an absolute number, commonly ranging from 0 (low risk) to 400 (high risk). These values can be translated into age- and sex-specific percentile values. Different imaging methods and protocols will produce different values based on the specific algorithm used to create the score, but the correlation between any 2 methods appears to be high, and scores from 1 method can be translated into scores from a different method.
REGULATORY STATUS
Many models of CT devices, including EBCT and other ultrafast CT devices, have been cleared for marketing by the U.S. Food and Drug Administration through the 510(k) process. Food and Drug Administration product code: JAK.

RATIONALE
This evidence review was created in December 1995 and has been updated regularly with searches of the MEDLINE database. The most recent literature update was performed through August 9, 2018.

Evidence reviews assess whether a medical test is clinically useful. A useful test provides information to make a clinical management decision that improves the net health outcome. That is, the balance of benefits and harms is better when the test is used to manage the condition than when another test or no test is used to manage the condition.

The first step in assessing a medical test is to formulate the clinical context and purpose of the test. The test must be technically reliable, clinically valid, and clinically useful for that purpose. Evidence reviews assess the evidence on whether a test is clinically valid and clinically useful. Technical reliability is outside the scope of these reviews, and credible information on technical reliability is available from other sources.

This review was informed, in part, by a TEC Assessment (1998). The Assessment concluded that the available evidence was sufficient to permit conclusions about the technology’s performance, but not the effect of the technology on health outcomes, especially when compared with other noninvasive methods of assessing coronary artery disease (CAD).

CORONARY ARTERY CALCIUM SCORING IN ASYMPTOMATIC INDIVIDUALS

Clinical Context and Test Purpose
The purpose of coronary artery calcium (CAC) scoring using computed tomography (CT) in asymptomatic patients is to assess who may benefit from preventive interventions targeted to minimize the risk of atherosclerotic cardiovascular disease (CVD). The question addressed in this evidence review is: Does CAC scoring result in an improved health outcome compared with CAD risk stratification based on standard risk factors among asymptomatic patients?

The following PICOTS were used to select literature to inform this review.

Patients
The population of interest is individuals who are asymptomatic with the risk of CAD.

Interventions
The intervention of interest is CAC scoring using fast CT imaging, including electron-beam computed tomography (EBCT) and spiral CT.

Comparators
The following tool is currently being used to make decisions about managing CVD in asymptomatic patients: CAD risk factor stratification based on standard risks, such as the Framingham Risk Score (FRS).

Outcomes
The outcomes of interest include overall survival, test accuracy, test validity, morbid events (eg, major adverse cardiac events [MACEs]), as well as the need for invasive coronary angiography (ICA) and revascularization.
Intermediate or surrogate outcomes of interest are changes in cardiac risk profile indicators such as smoking, hyperlipidemia, or hypertension.

**Timing**
CAC scoring is usually initiated or used to modify cardiac risk-reduction interventions in individuals asymptomatic for CAD.

**Setting**
CAC scoring using CT is administered in a primary care or general cardiology practice setting.

**Technically Reliable**
Assessment of technical reliability focuses on specific tests and operators and requires review of unpublished and often proprietary information. Review of specific tests, operators, and unpublished data are outside the scope of this evidence review and alternative sources exist. This evidence review focuses on the clinical validity and clinical utility.

**Clinically Valid**
A test must detect the presence or absence of a condition, the risk of developing a condition in the future, or treatment response (beneficial or adverse).

**Systematic Reviews**
Xie et al (2013) conducted a systematic review and meta-analysis to determine the correlation in calcium score between nontriggered and electrocardiography-triggered CT. The pooled correlation coefficient for calcium score from the meta-analysis of 3 studies (661 participants) was 0.94 (95% confidence interval [CI], 0.89 to 0.97). The pooled Cohen’s κ from 2 studies (533 participants) was 0.89 (95% CI, 0.83 to 0.95) for 4 categories of calcium scores (0, 1-99, 100-399, ≥400). Heterogeneity was observed in the pooling calculation of the calcium score (p<0.001 for Q statistic, I²>50%).

**Observational Studies**
From a pool of 27,125 patients who had had coronary computed tomography angiography (CCTA) for CAD, Han et al (2018) evaluated 3145 asymptomatic elderly patients between 52 and 62 years of age to compare the prognostic value of CCTA and CAC score. In this multicenter prospective observational study, the authors found that adding CCTA improved the level of discrimination of a model that only included FRS and CAC score (C statistic: 0.75 vs 0.70, p=0.015). The authors did not correlate the potential impact of CCTA results with treatment choices and downstream events. The study had a relatively short follow-up, and substantial disparity in the duration of risk prediction, FRS in particular.

Lee et al (2017) conducted a long-term study comparing the efficacy of risk prediction models using CCTA in 933 asymptomatic patients with type 2 diabetes with traditional risk factor models. Of the 94 patients with MACE who exhibited obstructive CAD, the performance of a risk prediction model was significantly improved (C index 0.788; 95% CI, 0.747 to 0.829; p=0.035) by adding CCTA to traditional risk factors. The risk prediction model using the CAC score remained unimproved (C index, 0.740, p=0.547). Small sample size, the lack of a standardized protocol for conducting coronary angiograms and/or percutaneous coronary interventions and medications after CCTA, and the uniformly high-risk characteristics of the study population limit conclusions to be drawn from this observational study.

**Retrospective Studies**
Takamura et al (2017) retrospectively evaluated the incremental prognostic value of adding CCTA to plaque findings in 339 asymptomatic patients. FRS, CAC score, and CT-verified high-risk plaque were the standard predictors of cardiac events investigated; CT-verified high-risk plaque results were based on
Computed Tomography to Detect Coronary Artery Calcification

CCTA findings. Using multivariate Cox proportional hazard analysis, the authors determined that both CAC score (hazard ratio, 13.23; 95% CI, 1.62 to 107.78; p<0.016) and CT-verified high-risk plaque (hazard ratio, 11.27; 95% CI, 1.24 to 102.12; p<0.032) independently predicted cardiac events. Using net reclassification indices and integrated discrimination improvement reclassification, the authors calculated the improvement in predictive accuracy by adding CT-verified high-risk plaque findings. The net reclassification indices was 0.9556 (p<.001) and integrated discrimination improvement was 0.2582 (p<0.020), which suggested that the addition of CT-verified high-risk plaque improved the diagnostic performance of the CAC score and FRS. The retrospective design, inability to follow all patients, inability to clarify the patient use of oral medications, a small number of cases, and the paucity of cardiac events are the limitations of this study.

Gepner et al (2017) prospectively evaluated CVD, coronary heart disease (CHD), and stroke or transient ischemic attack events to compare the use of CAC with carotid plaque scores to predict CVD events; the study used data from the Multi-Ethnic Study of Atherosclerosis (MESA), a population-based cohort of individuals without known CVD. After 11.3 years of follow-up among 4955 participants (mean age, 61.6 years), 709 CVD, 498 CHD, and 262 stroke/transient ischemic attack events had occurred. CAC score significantly reclassified non-CVD events (3%; 95% CI, 2% to 5%) and CHD events (13%; 95% CI, 5% to 18%). Carotid plaque score did not consistently reclassify CVD or CHD events or nonevents.

Nakanishi et al (2016) conducted a study among 13,092 consecutive asymptomatic individuals without known CAD (mean age, 58 years) clinically referred for a CAC scan between 1997 and 2011 at a university medical center; the study examined the predictive value of CAC for 5- and 15-year mortality rates among men and women. CAC showed an incremental prognostic value over traditional risk factors among men at 5 years (area under curve [AUC], 0.702 vs 0.655; p=0.002) as well as at 15 years (AUC, 0.723 vs 0.656; p<0.001). In women, the incremental prognostic value of CAC was not statistically significant at 5 years (AUC, 0.650 vs 0.612; p=0.065) but was statistically significant at 15 years (AUC, 0.690 vs 0.624; p<0.001).

Blaha et al (2016) conducted a study using data from MESA to compare the value of various negative risk markers. The authors evaluated the accuracy of change in risk classification by calculating the net reclassification improvement (NRI) for each of the 13 negative risk markers. During a median of 10.3 years of follow-up among a cohort of 6814, 710 CVD events occurred. Among all the negative risk markers, a CAC score of 0 was the strongest, with an adjusted mean diagnostic likelihood ratio of 0.41 for all CHD. NRI for downward reclassification (10-year CVD risk, <7.5%) of CVD events with CAC scores of 0 in participants with a pretest 10-year CVD risk of 7.5% or higher (n=3833 [3227 participants without events and 606 with events]) was 0.14, higher than other negative risk markers included in the study.

Won et al (2015) conducted a single-center cross-sectional study of 328 consecutive asymptomatic patients with type 2 diabetes who underwent CCTA between 2008 and 2009 in a hospital in South Korea to evaluate the predictive value of the CAC score for obstructive coronary plaques (OCP) detected by CCTA. On the basis of CAC scores of 0, 1 to 10, 11 to 100, or greater than 100, OCPs were found in 2%, 5%, 15%, and 36% of patients, respectively. On receiver operating characteristic curve analysis, the optimal cutoff CAC score for predicting OCPs was found to be 33, with 83% sensitivity and 81% specificity (AUC=0.853; 95% CI, 0.777 to 0.930; p<0.001). Positive and negative predictive values of a CAC score of 33 for OCPs were 30% and 98%, respectively. On multivariate logistic regression analysis, age (odds ratio [OR], 1.09), microalbuminuria levels (OR=3.43), current smoker (OR= 3.93), and a CAC score greater than 33 (OR=15.85) were found to be independently associated with an increased risk for OCPs (p<0.05).
Elias-Smale et al (2011) conducted a study among 2153 asymptomatic participants (69.6 years) who underwent a multidetector computed tomography scan. During a median follow-up of 3.5 years, 58 CHD events (myocardial infarction or death) occurred. Participants were classified into low (<5%), intermediate (5%-10%), and high (>10%) 5-year risk categories based on a refitted Framingham risk model. For the outcome of CHD, the C statistic improved from 0.693 for the refitted Framingham model to 0.743 by addition of coronary calcium. Reclassification of subjects occurred most substantially in the intermediate-risk group (5-year risk, 5%-10%) where 56% of persons were reclassified. Addition of CAC scoring reclassified 56% of persons: 36% moved to low risk while 20% moved to high risk, leading to a net gain in reclassification of 18% in persons with an event and a net decline in reclassification of 3% in persons without event, resulting in an NRI of 15% (p<0.01).

Polonsky et al (2010) also used data from MESA to determine whether incorporation of calcium score into a risk model based on traditional risk factors would improve the classification of risk. During a median of 5.8 years of follow-up among a final cohort of 5878, 209 CHD events occurred, of which 122 were myocardial infarction, death from CHD, or resuscitated cardiac arrest. Addition of CAC score in the model resulted in significant improvements in risk prediction compared with the model without CAC score (NRI=0.25; 95% CI, 0.16 to 0.34; p<0.001). Subjects reclassified to high risk had a similar risk of CHD events as those originally classified as high risk.

A number of more recent studies have reported that CAC scoring adds predictive information.

Section Summary: Clinically Valid
Multiple prospective cohort studies have consistently demonstrated the incremental prognostic value of CAC scoring in predicting CHD and mortality over traditional risk factors among asymptomatic populations over the intermediate and long term. However, considering the heterogeneity of methods applied and inherent limitations of observational studies, there is a need for more evidence on diagnostic accuracy of CAC scoring in predicting CHD risk among the asymptomatic population, preferably from randomized controlled trials (RCTs).

Clinically Useful
A test is clinically useful if the use of the results informs management decisions that improve the net health outcome of care. The net health outcome can be improved if patients receive correct therapy, or more effective therapy, or avoid unnecessary therapy, or avoid unnecessary testing.

Direct Evidence
Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from RCTs.

Systematic Reviews
Tables 1 and 2 summarize, respectively, the characteristics and results of systematic reviews relevant to the assessment of the clinical utility of CAC scoring.

Mamudu et al (2014) conducted a systematic review of studies evaluating the effects of CAC screening on behavioral modification, risk perception, and medication adherence in asymptomatic adults. Fifteen studies were selected (3 RCTs, 12 observational studies). The size of the study populations ranged from 56 to 6814 individuals. Reviewers primarily provided descriptive results of the studies given the lack of standardization across studies regarding CAC measures and outcome variables. CAC screening improved medication adherence. However, the impact of CAC screening on behavioral and lifestyle factors (body
mass index, diet, exercise, smoking), the perception of CAD risk, and psychosocial effects were not statistically significant compared with baseline.

Xie et al (2013) conducted a systematic review to evaluate the prognostic performance of the CAC score derived from nontriggered CT. In 5 studies, 34,028 cardiac asymptomatic patients were followed for a mean of 45 months (range, 0-72 months). No meta-analysis was performed on the studies because of large heterogeneity in calcium quantification methods, calcium score categorization, and outcomes. During follow-up, 207 cardiovascular deaths and 675 cardiovascular events were observed. Overall, increasing unadjusted and adjusted hazard ratios were observed with increasing calcium score categories.

Whelton et al (2012) published a meta-analysis of RCTs that evaluated the impact of CAC scores on cardiac risk profiles and cardiac procedures. Four trials were identified (total N=2490 participants); the individual trials ranged in size from 50 to 1934 patients. Reviewers pooled data from 4 trials on the impact of calcium scores on blood pressure, from three to evaluate the impact on low-density lipoprotein, and from two to determine the impact on high-density lipoprotein. Pooled analysis did not show a significant change in any of these parameters when incorporating calcium scores. Similarly, in 4 studies that looked at the rates of smoking cessation following calcium scores, no significant change was found. Two studies included rates of coronary angiography and two included rates of revascularization. Pooled analysis of these studies did not show a significant change after measurement of coronary calcium.

Sarwar et al (2009) conducted a systematic review and meta-analysis to examine the prognostic utility of CAC scoring in categorizing asymptomatic patients according to their risk for adverse events. Thirteen studies assessing the relation between CAC and adverse cardiovascular outcomes (total N=71,595 asymptomatic patients; 65% men) were included in the analysis. Among the participants, 29,312 (41%) did not have any evidence of CAC (range, 22%-80% of patients per study). During a mean follow-up of 50 months (range, 32-102 months), 154 (0.47%) of 29,312 patients without CAC and 1749 (4.14%) of 42,283 patients with CAC had cardiovascular events. The pooled relative risk was 0.15 (95% CI, 0.11 to 0.21; p<0.001).

Table 1. Characteristics of Systematic Reviews Assessing the Clinical Utility of CAC Score for Asymptomatic Patients

<table>
<thead>
<tr>
<th>Study</th>
<th>Dates</th>
<th>Trials</th>
<th>Participants</th>
<th>N (Range)</th>
<th>Design</th>
<th>Duration (Range)</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mamudu et al (2014)</td>
<td>1996-2014</td>
<td>15</td>
<td>Asymptomatic for CAD</td>
<td>16,983 (56-6814)</td>
<td>SR of RCTs and prospective cohorts</td>
<td>3 mo to &gt;8 y</td>
<td>Positive behavioral change, risk perception, medication adherence</td>
</tr>
<tr>
<td>Xie et al (2013)</td>
<td>2008-2011</td>
<td>5</td>
<td>Asymptomatic for CAD</td>
<td>34,028 (1159-10,410)</td>
<td>SR of cohort studies</td>
<td>Mean, 45 mo (10-72 mo)</td>
<td>Cardiovascular deaths and events</td>
</tr>
</tbody>
</table>
Computed Tomography to Detect Coronary Artery Calcification

<table>
<thead>
<tr>
<th>Study</th>
<th>Treatment</th>
<th>Comparator</th>
<th>Trials</th>
<th>Measure</th>
<th>Association</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xie et al (2013)</td>
<td>CAC score of 0 (n=8487)</td>
<td>Positive CAC</td>
<td>2</td>
<td>Event rates (cardiovascular deaths)</td>
<td>0.55% vs 2.50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAC score of 0 (n=5249)</td>
<td>Positive CAC</td>
<td>2</td>
<td>Event rates (cardiovascular events)</td>
<td>1.30% vs 4.50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whelton et al (2012)</td>
<td>CAC screen</td>
<td>No CAC screen</td>
<td>4</td>
<td>Mean change in systolic BP</td>
<td>0.23</td>
<td>-2.25 to 2.71</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAC screen</td>
<td>No CAC screen</td>
<td>3</td>
<td>Mean change in diastolic BP</td>
<td>-0.42</td>
<td>-1.18 to 0.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAC screen</td>
<td>No CAC screen</td>
<td>3</td>
<td>Mean change in LDL</td>
<td>0.23</td>
<td>-5.96 to 6.42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAC screen</td>
<td>No CAC screen</td>
<td>2</td>
<td>Mean change in HDL</td>
<td>-1.18</td>
<td>-5.50 to 3.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAC screen</td>
<td>No CAC screen</td>
<td></td>
<td>RR of smoking cessation</td>
<td>1.15</td>
<td>0.77 to 1.71</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAC screen</td>
<td>No CAC screen</td>
<td></td>
<td>RR of angiography</td>
<td>1.17</td>
<td>0.68 to 1.99</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAC screen</td>
<td>No CAC screen</td>
<td></td>
<td>RR of revascularization</td>
<td>1.35</td>
<td>0.69 to 2.63</td>
<td></td>
</tr>
<tr>
<td>Sarwar et al (2009)</td>
<td>CAC score of 0 (n=29,312)</td>
<td>Positive CAC</td>
<td>13</td>
<td>RR of adverse cardiovascular outcome</td>
<td>0.15</td>
<td>0.11 to 0.21</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

BP: blood pressure; CAC: coronary artery calcium; CI: confidence interval; HDL: high-density lipoprotein; LDL: low-density lipoprotein; RR: relative risk; SBP: systolic blood pressure.

**Table 2. Results of Systematic Reviews Assessing the Impact of CAC Score on Clinical Risk Profile, Cardiac Procedures, and Cardiovascular Events Among Asymptomatic Patients**

Randomized Controlled Trials

RCTs by Rozanski et al (2011) and O’Malley et al (2003), both included in the 2012 Whelton systematic review, captured the effect of incorporating CAC scoring in clinical practice on CAD risk factors and overall CAD risk.

Rozanski et al (2011) conducted an RCT to evaluate the impact of CT scanning for CAC on cardiac risk factors. A total of 2137 healthy volunteers were randomized in a 2:1 ratio to CT scanning (n=1424) or no CT scanning (n=713) and followed for 4 years. At baseline, both groups received 1 session of risk factor counseling by a nurse practitioner. The primary end point was 4-year change in CAD risk factors and FRS. At the 4-year follow-up, there was a differential dropout among the groups, with 88.2% (1256/1424) of follow-up in the scan group and 81.9% (584/713) in the no-scan group. Compared with the no-scan group, the scan group showed a net favorable change in systolic blood pressure (p=0.02),
low-density lipoprotein cholesterol (p=0.04), and waist circumference for those with increased abdominal girth (p=0.01), and a tendency to weight loss among overweight subjects (p=0.07). While there was a mean rise in FRS in the no-scan group (0.7), FRS remained static in the scan group (0.002; p=0.003). Downstream medical testing in the scan group were comparable with those of the no-scan group, balanced by lower and higher resource utilization for subjects with normal CAC scans and CAC scores of 400 or higher, respectively.

This trial highlights the potential benefit of CAC screening in modifying the cardiac risk profile but is not definitive in demonstrating improved outcomes. Trial limitations included differing intensities of interventions between groups and differential dropout. It is possible that the small differences reported in the trial resulted from bias related to these methodologic limitations. Also, this trial did not compare the impact of other types of risk factor intervention, most notably more intensive risk factor counseling. Finally, the generalizability of the findings is uncertain, because this was a volunteer population that might have been highly motivated for change.

O’Malley et al (2003) conducted an RCT among a consecutive sample of 450 asymptomatic active-duty U.S. Army personnel ages 39 to 45 years to assess the effects of incorporating EBCT as a motivational factor into a cardiovascular screening program.24 The program offered intensive case management or usual care and assessed treatment impact on 10-year FRS over 1 year. The authors used a 2×2 factorial design and patients were randomized to 1 of the 4 intervention arms: EBCT results provided in the setting of intensive case management (n=111) or usual care (n=119) or EBCT results withheld in the setting of intensive case management (n=124) or usual care (n=96). Mean absolute risk change in 10-year FRS between groups receiving and not receiving results was +0.30 and +0.36 (p=0.81), respectively. The trial was not powered for clinical end points. EBCT did not produce any benefits regarding a difference in FRS at 1 year.

**Chain of Evidence**
Indirect evidence on clinical utility rests on clinical validity. If the evidence is insufficient to demonstrate test performance, no inferences can be made about clinical utility.

While there is evidence CAC scoring has a degree of clinical validity, uncertainty remains in the magnitude of increased risk conferred by a given CAC score. For this reason, a chain of evidence supporting the clinical utility of CAC scoring in this population currently cannot be constructed.

**Section Summary: Clinically Useful**
Multiple prospective studies have found that CAC scoring is associated with future risk of CHD events. CAC scores likely add to the predictive ability of clinical risk prediction models. However, relevant studies enrolled different populations, assessed different traditional risk factors, and assessed different coronary disease outcomes. Different calcium score cutoffs were analyzed in these studies. Given the variation across studies, the magnitude of increased risk conferred by a given calcium score is still uncertain. Studies that evaluated the use of CAC scoring in asymptomatic patients have reported mixed findings on whether the score led to improved cardiovascular risk profiles or improvements in other meaningful clinical outcomes. The meta-analysis of RCTs did not find significant improvements in cardiac risk profiles, smoking cessation, or incidence of subsequent cardiac procedures with the use of CAC scoring.

**CAC Scoring in Symptomatic Patients**
In certain clinical situations, such as patients presenting with chest pain, it is uncertain whether the symptoms are due to CAD. Coronary calcium measurement has been proposed as a method to rule out CAD in certain patients if their CAC score is 0. The presence of any coronary calcium can be a sensitive
Computed Tomography to Detect Coronary Artery Calcification

but not specific test for coronary disease because CAD rarely occurs in the absence of coronary calcium, False-positives occur because the calcium may not be associated with an ischemic lesion. The absence of any coronary calcium can be a specific test for the absence of coronary disease and direct the diagnostic workup toward other causes of the patient’s symptoms. In this context, coronary calcium measurement is not used to make a positive diagnosis but as a diagnostic “filter” to rule out an atherosclerotic cause for the patient’s symptoms.

**Clinical Context and Test Purpose**
The use of CAC scoring with CT in symptomatic patients can rule out the atherosclerotic etiology of CAD.

The question addressed in this evidence review is: In individuals with symptoms suggestive of CAD does CAC scoring rule out urgent or emergent CAD and improve net health outcomes?

The following PICOTS were used to select literature to inform this review.

**Patients**
The population of interest is individuals who have signs and/or symptoms suggestive of CAD.

**Interventions**
The intervention of interest is CAC scoring using fast CT imaging, including EBCT and spiral CT.

**Comparators**
The following test is currently being used to make decisions about managing CAD: standard diagnostic testing, which includes functional testing and exercise electrocardiograph.

**Outcomes**
The outcomes of interest include overall survival, test accuracy, test validity, morbid events (eg, MACEs, need for ICA and revascularization).

**Timing**
The timing of use of CT CAC scoring is when individuals require evaluation for persistent stable angina or experience onset of acute chest pain.

**Setting**
CAC scoring using CT is administered in a cardiology practice or emergent care setting for patients undergoing evaluation of chest pain.

**Technically Reliable**
Assessment of technical reliability focuses on specific tests and operators and requires review of unpublished and often proprietary information. Review of specific tests, operators, and unpublished data are outside the scope of this evidence review and alternative sources exist. This evidence review focuses on the clinical validity and clinical utility.

**Clinically Valid**
A test must detect the presence or absence of a condition, the risk of developing a condition in the future, or treatment response (beneficial or adverse).

**Systematic Reviews**
Chaikriangkrai et al (2016) conducted a systematic review and meta-analysis to examine the prognostic value and accuracy of a CAC score of 0 for identifying patients presenting with acute chest pain at acceptable low risk for future cardiovascular events. The systematic review included only prospective
cohort studies that used multidetector computed tomography or EBCT to calculate CAC scores using the Agatston method and reported MACEs at 1 month and beyond the index emergency department visit. Eight studies evaluating 3556 patients with a median follow-up of 10.5 months were selected. Reviewers conducted a subgroup analysis of 6 studies in predominantly white patients (n=2432 patients) to estimate the prognostic accuracy indices of CAC scores (0, >0) for cardiovascular events (MACEs, all-cause deaths, nonfatal myocardial infarction). Pooled sensitivity, specificity, as well as positive and negative likelihood ratios were 96% ($\chi^2=0\%$), 60% ($\chi^2=15.1\%$), 2.36 ($\chi^2=0\%$), and 0.07 ($\chi^2=0\%$), respectively (see Table 3).

The systematic review by Sarwar et al (2009), discussed above, examined the clinical, diagnostic, and prognostic significance of a CAC score of 0.22 Eighteen studies from 1992 to 2007, in which 10,355 symptomatic patients with suspected CAD underwent CAC testing as well as ICA, were selected in the analysis to examine the diagnostic accuracy of CAC scoring for stenosis on ICA. A total of 5805 (56%) patients had significant coronary stenosis (defined as >50%) on ICA. Pooled data revealed that the presence of calcium had a sensitivity, a specificity, as well as a positive and a negative likelihood ratio of 98%, 40%, 1.63, and 0.06, respectively, for predicting coronary artery stenosis. The summary negative predictive value was 92% (95% CI, 88% to 95%; p<0.001). The summary positive predictive value was 68% (95% CI, 64% to 72%; p<0.001) (see Table 3).

**Table 3. Pooled Diagnostic Performance of CAC Score for CAD Among Symptomatic Individuals**

<table>
<thead>
<tr>
<th>Test</th>
<th>Studies</th>
<th>N</th>
<th>Sensitivity (95% CI), %</th>
<th>Specificity (95% CI), %</th>
<th>LR+ (95% CI)</th>
<th>LR- (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chaikriangkrai et al (2016)25</td>
<td>6</td>
<td>2432</td>
<td>96 (93 to 98)</td>
<td>60 (58 to 62)</td>
<td>2.36 (2.22 to 2.51)</td>
<td>0.07 (0.04 to 0.14)</td>
</tr>
<tr>
<td>Sarwar et al (2009)22</td>
<td>18</td>
<td>10,355</td>
<td>98 (97 to 98)</td>
<td>40 (38 to 41)</td>
<td>1.63 (1.59 to 1.67)</td>
<td>0.06 (0.05 to 0.07)</td>
</tr>
</tbody>
</table>

CI: confidence interval; LR: likelihood ratio; CAC: coronary artery calcium; CAD: coronary artery disease.

**Randomized Controlled Trials**

Lubbers et al (2016) conducted a multicenter RCT to compare the effectiveness and safety of a cardiac CT algorithm with functional testing in patients with symptoms (stable chest pain or angina equivalent symptoms) suggestive of CAD.26 A total of 350 patients with stable angina were prospectively randomized 2:1 to cardiac CT or functional testing, such as exercise electrocardiograph, myocardial perfusion imaging, or stress echocardiography. Patients in the cardiac CT arm (n=242) initially underwent calcium scanning followed by CCTA if the Agatston score was between 1 and 400. CAD was ruled out if the patients had a CAC score of 0. The original primary end point of the trial was the proportion of patients undergoing catheter angiography followed by revascularization, but because of insufficient funding, authors could not assess that end point and chose clinical effectiveness as the alternative primary outcome, defined as the absence of chest pain complaints after 1 year. After 1 year, fewer patients randomized to CT reported angina symptoms that those in the functional testing group (39% vs 25%, p=0.012), although the proportion of patients with similar or worsened symptoms was comparable (26% vs 29%, p=0.595). The tiered protocol study design is a strength of this trial, but the unplanned change in end points limits analysis and conclusions.
**Observational Studies**

Pursnani et al (2015) published results from a subgroup analysis of the Rule Out Myocardial Infarction using Computed Assisted Tomography II trial.\(^{27}\) It evaluated the incremental diagnostic value of CAC scoring plus CCTA in low- to intermediate-risk patients presenting to the emergency department with symptoms (chest pain or angina equivalent of ≥5 minutes duration within 24 hours) suggesting acute coronary syndrome (ACS). The Rule Out Myocardial Infarction using Computed Assisted Tomography II trial randomized patients with possible ACS to CCTA as part of an initial evaluation or to the standard emergency department evaluation strategy, as directed by local caregivers. As part of the trial protocol, all patients undergoing CCTA had a CAC scan; the present analysis included 473 patients who underwent both CCTA and CAC scanning. Among these patients, the ACS rate (defined as unstable angina and myocardial infarction during the index hospitalization) was 8% (n=38). Patients with lower CAC scores were less likely to have a discharge diagnosis of ACS. Among 253 patients with a CAC score of 0, 2 (0.8%) patients were diagnosed with ACS (95% CI, 0.1% to 2.8%). Receiver operating characteristic curve analysis was used to predict the risk of ACS by CAC score greater than 0, continuous CAC score, CCTA results, and combined CAC and CCTA score. The optimal cut point of CAC for ACS detection was 22 (C statistic, 0.81), with 318 (67%) patients having a CAC score of less than 22. All CCTA strategies had high sensitivity for ACS detection, without significant differences in stenosis thresholds. CAC was inferior to CCTA for predicting ACS (C range, 0.86 vs 0.92; p=0.03). The addition of CAC score to CCTA (ie, using selective CCTA only for patients with CAC score >22 or >0) did not significantly improve the detection of ACS (CAC plus CCTA C=0.93 vs CCTA C=0.92; p=0.88). Overall, this trial suggested that CAC scoring did not provide incremental value beyond CCTA in predicting the likelihood of ACS in a low- to intermediate-risk population presenting to the emergency department.

Hulten et al (2014) published results from a retrospective cohort study among symptomatic patients without a history of CAD to evaluate the accuracy of CAC scoring for excluding coronary stenosis, using CCTA as the criterion standard.\(^{28}\) The study included 1145 patients who had symptoms possibly consistent with CAD who underwent noncontrast CAC scoring and contrast-enhanced CCTA from 2004 to 2011. For detection of greater than 50% stenosis, CAC had a sensitivity, specificity, and negative predictive value of 98%, 55%, and 99%, respectively. For prediction of cardiovascular death or myocardial infarction, the addition of either or both CAC and CCTA to a clinical prediction score did not significantly improve prognostic value.

Chaikriangkrai et al (2015) retrospectively evaluated whether CAC added incremental value to CCTA for predicting coronary artery stenosis in 805 symptomatic patients without known CHD.\(^{29}\) CAC score was significantly associated with the presence of coronary artery stenosis on CCTA. Both CAC score and the presence of CCTA stenosis were significantly associated with MACE rates, including cardiac death, nonfatal myocardial infarction, and late coronary revascularization. Patients with more than 50% stenosis on CCTA had higher MACE rates, compared with those who had a normal CCTA (4.5% vs 0.1%, p<0.001) and with those who had less than 50% stenosis (4.5% vs 1.4%, p=0.002). Those with a CAC score of more than 400 had higher MACE rates than those with scores between 1 and 100 (4.2% vs 1.4%, p=0.014) and those with scores of 0 (4.2% vs 0%, p<0.001). The addition of CAC score to a risk prediction model for MACE, which included clinical risk factors and CCTA stenosis, significantly improved the model’s predictive performance (global χ² score, 108 vs 70, p=0.019).

Dharampal et al (2013) retrospectively evaluated a cohort of 1975 symptomatic patients (those with chest pain referred by their cardiologist for CCTA) who underwent clinical evaluation and CAC scoring and CCTA or ICA.\(^{30}\) The primary outcome was obstructive CAD (≥50% stenosis) on ICA or CCTA (if ICA was not done). The authors evaluated the NRI with the addition of CAC score to a clinical prediction model.
for patients who had an intermediate probability of CHD (10%-90%) after clinical evaluation based on chest pain characteristic, age, sex, risk factors, and electrocardiogram. Discrimination of CAD was significantly improved by incorporating the CAC score into the clinical evaluation (AUC, 0.80 vs 0.89, p<0.001).

Yoon et al (2012) conducted a prospective study among 136 Korean men (58% men; age, 56 years) who presented to the emergency department with acute chest pain and nondiagnostic electrocardiograph to examine the diagnostic usefulness of the “zero calcium score criteria” as a decision-making strategy to rule out significant CAD as the etiology of acute chest pain. All patients underwent 64-slice CT for calcium scoring and CCTA. Ninety-two (68%) of 136 patients did not show detectable CAC, and 14 (15%) of these 92 without CAC had 50% or more stenosis on CCTA. Sensitivity, specificity, positive predictive value, and negative predictive value of a CAC score of 0 for the detection of 50% or more stenosis were 66% (95% CI, 50% to 80%), 83% (95% CI, 74% to 90%), 64% (95% CI, 48% to 77%), and 85% (95% CI, 75% to 91%), respectively. A calcium score of 0 did not necessarily guarantee the absence of significant CAD in an Asian population presenting to the emergency department with chest pain.

Gottlieb et al (2010) conducted a prospective multicenter study to evaluate whether the absence of coronary calcium could be used to rule out 50% or more coronary stenosis or the need for revascularization. The authors compared the diagnostic performance of 64-detector CT with that of ICA. Among 291 patients with suspected CAD included in the study, 214 (73%) were male, and the mean age was 59.3 years. Fifty-six percent of the patients had 50% or more stenosis. Among 72 patients with a CAC score of 0, 14 (19%) had at least 1 coronary artery with 50% or more stenosis. The overall sensitivity for a CAC score of 0 to predict the absence of 50% or more stenosis was 45%, specificity was 91%, the negative predictive value was 68%, and the positive predictive value was 81%. Additionally, 9 (12.5%) patients with a CAC score of 0 underwent revascularization within 30 days of calcium scoring.

Section Summary: Clinically Valid
Systematic reviews and meta-analyses have reported a very low negative likelihood ratio for CAC score in predicting MACEs and significant coronary stenosis, suggesting the potential value of calcium score of 0 in ruling out an atherosclerotic etiology of the disease. However, multiple observational studies with angiographic (CCTA or ICA) have suggested that a CAC score of zero may not rule out the presence of significant atherosclerotic CAD among symptomatic patients.

Clinically Useful
A test is clinically useful if the use of the results informs management decisions that improve the net health outcome of care. The net health outcome can be improved if patients receive correct therapy, or more effective therapy, or avoid unnecessary therapy, or avoid unnecessary testing.

Direct Evidence
Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from RCTs.

Observational Studies
Yerramasu et al (2014) prospectively assessed an evaluation algorithm including CAC scoring for patients presenting to a rapid access chest pain clinic with stable chest pain possibly consistent with CHD. Three hundred patients presenting with acute chest pain to 1 of 3 chest pain clinics underwent CAC scoring. If the CAC score was 1000 or more Agatston units, ICA was performed; if the CAC score was less than 1000, CCTA was performed. All patients with a CAC score of zero and low pretest likelihood of CHD had no obstructive CHD on CCTA and were event-free during follow-up. Of the 18 patients with CAC scores
from 400 to 1000, 17 (94%) had greater than 50% obstruction on subsequent CCTA and were referred for further evaluation, 14 (78%) of whom had obstructive CHD. Of 15 patients with CAC scores 1000 or more and who were referred for coronary angiography, obstructive CHD was present in 13 (87%). This study suggested that CAC scoring can be used in the acute chest pain setting to stratify decision-making for further testing.

Ten Kate et al (2013) prospectively evaluated the accuracy of cardiac CT, including CAC scoring with or without CCTA, in distinguishing heart failure due to CAD from heart failure due to non-CAD causes. Data on the predictive ability of a negative CAC score in ruling out CAD was also included. The study included 93 symptomatic patients with newly diagnosed heart failure of unknown etiology, all of whom underwent CAC scoring. Those with a CAC score greater than 0 underwent CCTA and, if the CCTA was positive for CAD (>20% luminal diameter narrowing), ICA was recommended. Forty-six percent of patients had a CAC score of zero. At a mean follow-up of 20 months, no patient with a CAC score of 0 had a myocardial infarction, underwent percutaneous coronary intervention, had a coronary artery bypass graft, or had signs of CAD.

Chain of Evidence
Indirect evidence on clinical utility rests on clinical validity. If the evidence is insufficient to demonstrate test performance, no inferences can be made about clinical utility.

Because the clinical validity of CAC scoring for asymptomatic patients has not been established, a chain of evidence supporting the clinical utility of CAC scoring in this population cannot be constructed.

Section Summary: Clinically Useful
Currently, evidence from nonrandomized observational studies has suggested very low short or long-term risk of cardiovascular events or death in patients having calcium scores of 0 compared with those having positive (>0) calcium scores. However, considering the inconsistency in evidence regarding the diagnostic accuracy of calcium scoring and lack of evidence from RCTs, further research is needed to examine the clinical utility of ruling out atherosclerotic CAD based on CAC score of 0.

SUMMARY OF EVIDENCE
For individuals who are asymptomatic with risk of CAD who receive CAC scoring, the evidence includes multiple systematic reviews, RCTs, and nonrandomized observational studies. Relevant outcomes are overall survival, test accuracy and validity, morbid events, and resource utilization. There is extensive evidence on the predictive value of CAC score screening for cardiovascular disease among asymptomatic patients, and this evidence has demonstrated that scanning has incremental predictive accuracy above traditional risk factor measurement. However, high-quality evidence demonstrating that the use of CAC scores in clinical practice leads to changes in patient management or in individual risk behaviors that improve cardiac outcomes is lacking. A meta-analysis of RCTs reported no significant change in coronary risk profile, downstream testing, or revascularization following screening using CAC scoring compared with no CAC scoring. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals with signs and/or symptoms suggestive of CAD who receive CAC scoring before other diagnostic testing, the evidence includes prospective and retrospective nonrandomized studies. Relevant outcomes are overall survival, test accuracy and validity, morbid events, and resource utilization. CAC scoring has potential as a diagnostic test to rule out CAD in patients presenting with symptoms or as a “gatekeeper” test before invasive imaging is performed. Evidence from observational studies has suggested that negative results on CAC scoring rule out CAD with good reliability. However, the evidence has been inconsistent, with some studies reporting lack of value when using a zero calcium
score to rule out CAD. Further prospective trials would be needed to demonstrate that such a strategy is effective in practice and is at least as effective as alternative strategies for ruling out CAD. To demonstrate that use of calcium scores improves the efficiency or accuracy of the diagnostic workup of symptomatic patients, rigorous studies defining exactly how CAC scores would be used in combination with other tests to triage patients would be necessary. The evidence is insufficient to determine the effects of the technology on health outcomes.

SUPPLEMENTAL INFORMATION

CLINICAL INPUT FROM PHYSICIAN SPECIALTY SOCIETIES AND ACADEMIC MEDICAL CENTERS

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

2011 Input

In response to requests, input was received from 2 specialty societies and 5 academic medical centers while this policy was under review in 2011. Input was mixed on the investigational status of coronary artery calcium screening. Four of the 7 reviewers agreed with the investigational status; three dissented. The dissenters primarily cited evidence on the accuracy of scanning for risk prediction of coronary artery disease.

2009 Input

In response to requests, input was received through 2 physician specialty societies and 4 academic medical centers while this policy was under review in 2009. Most providing input agreed with the conclusions of this policy (investigational) as approved in 2009.

PRACTICE GUIDELINES AND POSITION STATEMENTS

American Heart Association

The American Heart Association (AHA; 2006) issued a scientific statement on the use of cardiac computed tomography. Most of the document reviewed the utility of calcium scoring for the use of determining prognosis and diagnosis. In addition to reviewing a large body of evidence on calcium scoring, clinical recommendations were offered. No indications received a class I recommendation (ie, evidence and/or agreement that the procedure is useful and effective) (see Table 4).

Table 4. Use of CAC Scoring to Assess Cardiovascular Risk

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>COR</th>
</tr>
</thead>
<tbody>
<tr>
<td>“…patients with chest pain with equivocal or normal ECGs and negative cardiac enzymes…”</td>
<td>IIb</td>
</tr>
<tr>
<td>“…determining the etiology of cardiomyopathy…”</td>
<td>IIb</td>
</tr>
<tr>
<td>“…symptomatic patients, … in the setting of equivocal treadmill or functional tests”</td>
<td>IIb</td>
</tr>
<tr>
<td>Asymptomatic patients with “intermediate–CAD risk patients (eg, those with a 10% to 20% Framingham 10-year risk estimate).…”</td>
<td>IIb</td>
</tr>
<tr>
<td>“Asymptomatic persons … found to be at low risk (&lt;10% 10-year risk) and high risk (&gt;20% 10-year risk) do not benefit…..”</td>
<td>III</td>
</tr>
<tr>
<td>“…It is not recommended … in asymptomatic persons to establish the presence of obstructive disease for revascularization…..”</td>
<td>III</td>
</tr>
<tr>
<td>“Serial imaging for assessment of progression of coronary calcification is not indicated…..”</td>
<td>III</td>
</tr>
<tr>
<td>“…hybrid nuclear/CT imaging is not recommended….”</td>
<td>III</td>
</tr>
</tbody>
</table>
Class IIb evidence indicates usefulness or efficacy has been less well-established; class III evidence indicates the procedure or treatment is not useful or possibly harmful.

CAC: coronary artery calcium; CAD: coronary artery disease; COR: class of recommendation; CT: computed tomography; ECG: electrocardiograph.

American College of Cardiology Foundation et al
A joint 2007 clinical consensus document by the American College of Cardiology Foundation (ACCF), AHA, and other medical societies reviewed much of the same evidence as the AHA (2006) scientific statement. Formal grading of evidence and classification of clinical recommendations were not reported. This document concluded that the indications receiving an IIb recommendation in the 2006 scientific statement “may be reasonable.”

ACCF, AHA, and 7 others societies (2010) released recommendations on calcium scoring as part of their joint guidelines on the management of cardiovascular risk in asymptomatic patients. Table 5 summarizes the recommendations.

Table 5. Use of Calcium Scoring to Diagnose and Manage Cardiovascular Risk

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement of CAC is reasonable for cardiovascular risk assessment in asymptomatic adults at intermediate risk (10% to 20% 10-year risk).</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Measurement of CAC may be reasonable for cardiovascular risk assessment in persons at low to intermediate risk (6% to 10% 10-year risk).</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Persons at low risk (&lt;6% 10-year risk) should not undergo CAC measurement for cardiovascular risk assessment.</td>
<td>III</td>
<td>B</td>
</tr>
</tbody>
</table>

CAC: coronary artery calcium; COR: class of recommendation; LOE: level of recommendation;

ACCF, AHA, and 5 other societies (2012) released guidelines on the diagnosis and management of patients with stable ischemic heart disease that include recommendations on CAC scoring:

- Class IIb recommendation: For patients with a low to intermediate pretest probability of obstructive IHD, noncontrast cardiac computed tomography to determine the CAC score may be considered. (Level of Evidence: C)

ACCF, AHA, and 4 other medical associations (2014) updated their 2012 guidelines on the diagnosis and management of patients with stable ischemic heart disease and made no additional recommendations for CAC scoring.

National Institute for Health and Care Excellence
For patients with “stable chest pain who cannot be excluded by clinical assessment alone,” the National Institute for Health and Care Excellence recommended CT using 64-slice imaging.

U.S. PREVENTIVE SERVICES TASK FORCE RECOMMENDATIONS
The U.S. Preventive Services Task Force (2018) updated its recommendations on the use of nontraditional or novel risk factors in assessing coronary heart disease risk in asymptomatic persons. Calcium score was 1 of 3 nontraditional risk factors considered. Reviewers concluded that the current evidence was insufficient to assess the balance of benefits and harms of using any of the nontraditional risk factors studied to assess the risk of coronary disease in asymptomatic persons.
MEDICARE NATIONAL COVERAGE
There is no national coverage determination. In the absence of a national coverage determination, coverage decisions are left to the discretion of local Medicare carriers.

ONGOING AND UNPUBLISHED CLINICAL TRIALS
Some currently unpublished trials that might influence this review are listed in Table 6.

Table 6. Summary of Key Trials

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCT02014311</td>
<td>Myocardial Perfusion 320 MDCT Guided Treatment Strategy for the Clinical Management of Patient With Recent Acute-Onset Chest Pain. A Randomized Control Trial</td>
<td>600</td>
<td>June 2018 (ongoing)</td>
</tr>
<tr>
<td>Unpublished</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCT00969865a</td>
<td>Individualized Comprehensive Atherosclerosis Risk-reduction Evaluation Program</td>
<td>170</td>
<td>Dec 2016 (completed)</td>
</tr>
</tbody>
</table>

NCT: national clinical trial.

a Denotes industry-sponsored or cosponsored trial.

ESSENTIAL HEALTH BENEFITS
The Affordable Care Act (ACA) requires fully insured non-grandfathered individual and small group benefit plans to provide coverage for ten categories of Essential Health Benefits (“EHBs”), whether the benefit plans are offered through an Exchange or not. States can define EHBs for their respective state. States vary on how they define the term small group. In Idaho, a small group employer is defined as an employer with at least two but no more than fifty eligible employees on the first day of the plan or contract year, the majority of whom are employed in Idaho. Large group employers, whether they are self-funded or fully insured, are not required to offer EHBs, but may voluntary offer them.

The Affordable Care Act requires any benefit plan offering EHBs to remove all dollar limits for EHBs.

REFERENCES
1. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Diagnosis and screening for coronary artery disease with electron beam computed tomography. TEC Assessments. 1998;Volume 13:Tab 27.


24. O'Malley PG, Feuerstein IM, Taylor AJ. Impact of electron beam tomography, with or without case management, on motivation, behavioral change, and cardiovascular risk profile: a randomized controlled trial. *JAMA.* May 7 2003;289(17):2215-2223. PMID 12734132


**CODES**

<table>
<thead>
<tr>
<th>Codes</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPT</td>
<td>75571</td>
<td>Computed tomography, heart, without contrast material, with</td>
</tr>
</tbody>
</table>
### Computed Tomography to Detect Coronary Artery Calcification

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>75572</td>
<td>Computed tomography, heart, with contrast material, for evaluation of cardiac structure and morphology (including 3D image postprocessing, assessment of cardiac function, and evaluation of venous structures, if performed)</td>
</tr>
<tr>
<td>75573</td>
<td>Computed tomography, heart, with contrast material, for evaluation of cardiac structure and morphology in the setting of congenital heart disease (including 3D image postprocessing, assessment of LV cardiac function, RV structure and function, and evaluation of venous structures, if performed)</td>
</tr>
<tr>
<td>75574</td>
<td>Computed tomographic angiography, heart, coronary arteries and bypass grafts (when present), with contrast material, including 3D image postprocessing (including evaluation of cardiac structure and morphology, assessment of cardiac function, and evaluation of venous structures, if performed)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HCPCS</th>
<th>S8092</th>
<th>Electron beam computed tomography (also known as ultrafast CT, cine CT)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ICD-10-CM</th>
<th>I25.10-I25.119</th>
<th>Investigational for all relevant diagnoses</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICD-10-CM</td>
<td>I25.700-I25.799</td>
<td>Atherosclerosis of coronary artery bypass graft(s) and coronary artery of transplanted heart with angina pectoris</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ICD-10-PCS</th>
<th>Z13.6</th>
<th>Encounter for screening for cardiovascular disorders</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>ICD-10-PCS</th>
<th>B221ZZZ, B223ZZZ</th>
<th>Imaging, heart, computed tomography (CT), no contrast (code by body part – coronary arteries, multiple or coronary artery bypass grafts, multiple)</th>
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</table>

**Type of Service**: Radiology  
**Place of Service**: Outpatient/inpatient

### POLICY HISTORY

<table>
<thead>
<tr>
<th>Date</th>
<th>Action</th>
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</thead>
<tbody>
<tr>
<td>05/22/14</td>
<td>Replace policy</td>
<td>Policy updated with literature review through April 14, 2014. References 6, 11, 21-22, 24-25, and 31-32 added. Editorial changes made to Rationale, Summary, and Guidelines sections. No change in policy statement.</td>
</tr>
<tr>
<td>05/21/15</td>
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<td>Policy updated with literature review through April 16, 2015; references 12, 16, 24, 26, 29, 31, and 38 added. Policy statement unchanged.</td>
</tr>
<tr>
<td>09/08/16</td>
<td>Replace policy</td>
<td>Policy updated with literature review through July 26, 2016; references 2, 15, and 37 added. Policy statement unchanged.</td>
</tr>
<tr>
<td>09/28/17</td>
<td>Replace policy</td>
<td>Blue Cross of Idaho adopted changes as noted. Policy updated with literature review through July 26, 2017; references 2-7, 11, 14, 16, 18, 24-25, 31-33, and 40 added. Policy statement unchanged.</td>
</tr>
<tr>
<td>09/19/18</td>
<td>Replace policy</td>
<td>Blue Cross of Idaho adopted changes as noted. Policy updated with literature review through</td>
</tr>
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</table>

**Original Policy Date**: December 1995  
**Page**: 21
| literature review through August 9, 2018; references 3-5 and 40-42 added. Policy statement unchanged. |