6.01.43	Contrast-Enhanced Computed Tomographic Angiography for Coronary Artery Evaluation		
Original Policy Date:	April 3, 2009	**Effective Date:**	February 1, 2022
Section:	6.0 Radiology	**Page:**	Page 1 of 34

Policy Statement

Contrast-enhanced coronary computed tomography angiography (CCTA) may be considered **medically necessary** for evaluation of patients with acute chest pain and without known coronary artery disease in the emergency department setting.

Contrast-enhanced coronary computed tomography angiography (CCTA) may be considered **medically necessary** for evaluation of patients with stable chest pain and meeting guideline criteria for a noninvasive test in the outpatient setting (see Policy Guidelines).

Contrast-enhanced coronary computed tomography angiography (CCTA) may be considered **medically necessary** for evaluation of patients with suspected anomalous (native) coronary arteries.

Contrast-enhanced coronary computed tomography angiography (CCTA) for coronary artery evaluation is considered **investigational** for all other indications.

NOTE: Refer to Appendix A to see the policy statement changes (if any) from the previous version.

Policy Guidelines

The 2012 collaborative medical association guidelines for the diagnosis and management of patients with stable heart disease list several class I recommendations on the use of noninvasive testing in patients with suspected stable ischemic heart disease. A class I recommendation indicates that a test should be performed. In general, patients with at least intermediate risk (10% to 90% risk by standard risk prediction instruments) are recommended to have some type of test, the choice depending on interpretability of the electrocardiogram, capacity to exercise, and presence of comorbidity.

Coding

The following code is a category I CPT code for this service:

- **75574**: 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)

Description

Contrast-enhanced coronary computed tomography angiography (CCTA) is a noninvasive imaging test that requires the use of intravenously administered contrast material and high-resolution, high-speed computed tomography machinery to obtain detailed volumetric images of blood vessels. It is a potential diagnostic alternative to current tests for cardiac ischemia (i.e., noninvasive stress testing and/or coronary angiography).

Related Policies

- Computed Tomography to Detect Coronary Artery Calcification

Benefit Application

Benefit determinations should be based in all cases on the applicable contract language. To the extent there are any conflicts between these guidelines and the contract language, the contract language will control. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

Some state or federal mandates (e.g., Federal Employee Program [FEP]) prohibits plans from denying Food and Drug Administration (FDA)-approved technologies as investigational. In these instances, plans may have to consider the coverage eligibility of FDA-approved technologies on the basis of medical necessity alone.

Regulatory Status

CCTA is performed using multidetector-row computed tomography, and multiple devices have been cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process. Current machines are equipped with at least 64 detector rows. Intravenous iodinated contrast agents used for CCTA also have received FDA approval.

Rationale

Background

Coronary Artery Disease

Various noninvasive tests are used to diagnose coronary artery disease (CAD). These tests can be broadly classified as those that detect functional or hemodynamic consequences of obstruction and ischemia (exercise treadmill testing, myocardial perfusion imaging, stress echocardiography with or without contrast), and others that identify the anatomic obstruction itself (coronary computed tomography angiography [CCTA], coronary magnetic resonance imaging).[1] Functional testing involves inducing ischemia by exercise or pharmacologic stress and detecting its consequences. However, not all patients are candidates. For example, obesity or obstructive lung disease can make obtaining echocardiographic images of sufficient quality difficult. Conversely, the presence of coronary calcifications can impede detecting coronary anatomy with CCTA.

Diagnostic Testing

Some tests will be unsuitable for particular patients. The presence of dense arterial calcification or an intracoronary stent can produce significant beam-hardening artifacts and may preclude satisfactory imaging. The presence of an uncontrolled rapid heart rate or arrhythmia hinders the ability to obtain diagnostically satisfactory images. Evaluation of the distal coronary arteries is more difficult than the visualization of the proximal and mid-segment coronary arteries due to greater cardiac motion and the smaller caliber of coronary vessels in distal locations. Evaluation of obstructive CAD involves quantifying arterial stenoses to determine whether significant narrowing is present. Lesions with stenosis more than 50% to 70% in diameter accompanied by symptoms are considered significant.

Contrast-enhanced CCTA is a noninvasive imaging test that requires the use of intravenously administered contrast material and high-resolution, high-speed computed tomography machinery to obtain detailed volumetric images of blood vessels. It has been suggested that CCTA may help rule out CAD and avoid invasive coronary angiography in patients with a low clinical likelihood of significant CAD. Also of interest is the potentially important role of nonobstructive plaques (i.e., those associated with <50% stenosis) because their presence is associated with increased cardiac event rates.[2] CCTA also can visualize the presence and composition of these plaques and quantify plaque burden better than conventional

angiography, which only visualizes the vascular lumen. Plaque presence has been shown to have prognostic importance.

The use of electron-beam computed tomography or helical computed tomography to detect coronary artery calcification is addressed in Blue Shield of California Medical Policy: Computed Tomography to Detect Coronary Artery Calcification.

Coronary Arterial Anomalies
Congenital coronary arterial anomalies (i.e., abnormal origin or course of a coronary artery) that lead to clinically significant problems are relatively rare. Symptomatic manifestations may include ischemia or syncope. Clinical presentation of anomalous coronary arteries is difficult to distinguish from other more common causes of cardiac disease; however, an anomalous coronary artery is an important diagnosis to exclude, particularly in young patients who present with unexplained symptoms (e.g., syncope). There is no specific clinical presentation to suggest a coronary artery anomaly.

Radiation Exposure
Exposure to ionizing radiation increases lifetime cancer risk.[3] Three studies have estimated excess cancer risks due to radiation exposure from CCTA. Assuming a 16-mSv dose, Berrington de Gonzalez et al (2009) estimated the 2.6 million CCTAs performed in 2007 would result in 2700 cancers or approximately 1 per 1000.[4] Smith-Bindman et al (2009) estimated that cancer would develop in 1 of 270 women and 1 of 600 men, age 40 undergoing CCTA with a 22-mSv dose.[5] Einstein et al (2007) employed a standardized phantom to estimate organ dose from 64-slice CCTA.[6] With modulation and exposures of 15 mSv in men and 19 mSv in women, calculated lifetime cancer risk at age 40 was 7 per 1000 men (1/143) and 23 per 1000 women (1/43). However, estimated radiation exposure used in these studies was considerably higher than received with current scanners-now typically under 10 mSv and often less than 5 mSv with contemporary machines and radiation reduction techniques. For example, in the 47-center Prospective Multicenter Study on Radiation Dose Estimates of Cardiac CT Angiography I (PROTECTION I) study enrolling 685 patients, the mean radiation dose was 3.6 mSv, using a sequential scanning technique.[7] In a study of patients undergoing an axial scanning protocol, Hausleiter et al (2012) reported on a mean radiation dose of 3.5 mSv and produced equivalent ratings of image quality compared with helical scan protocols, which had much higher mean radiation doses of 11.2 mSv.[8]

Levels of radiation delivered with the current generation scanners using reduction techniques (prospective gating and spiral acquisition) have declined substantially-typically to under 10 mSv. For example, an international registry developed to monitor CCTA radiation exposure has reported a median of 2.4 mSv (interquartile range, 1.3 to 5.5).[9] By comparison, radiation exposure accompanying rest-stress perfusion imaging varies by isotope used - approximately 5 mSv for rubidium 82 (positron emission tomography), 14 mSv for fluorine 18 fluorodeoxyglucose, 9 mSv for sestamibi (single-photon emission computed tomography), and 41 mSv for thallium; during diagnostic invasive coronary angiography, approximately 7 mSv is delivered.[10] Electron-beam computed tomography using electrocardiogram triggering delivers the lowest dose (0.7 to 1.1 mSv with 3-mm sections). Any cancer risk due to radiation exposure from a single cardiac imaging test depends on age (higher with younger age at exposure) and sex (greater for women).[11,6,5] Empirical data have suggested that every 10 mSv of exposure is associated with a 3% increase in cancer incidence over 5 years.[12]

Incidental Findings
A number of studies using scanners with 64 or more detector rows were identified.[13-21] Incidental findings were frequent (26.6% to 68.7%) with pulmonary nodules typically the most common and cancers typically more rare (»5/1000 or less). Aglan et al (2010) compared the prevalence of incidental findings when the field of view was narrowly confined to the cardiac structures with that when the entire thorax was imaged.[13] As expected, incidental findings were less frequent in

the restricted field (clinically significant findings in 14% versus 24% when the entire field was imaged).

Literature Review
This review has been informed by several Technology Evaluation Center (TEC) Assessments (2005, 2006, 2011).[22,23,24]

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.

Patients With Acute Chest Pain Presenting in the Emergency Setting
Clinical Context and Test Purpose
The purpose of coronary computed tomography angiography (CCTA) imaging in patients with acute chest pain is to diagnose coronary artery obstruction and guide treatment decisions.
The question addressed in this evidence review is: Does the use of CCTA improve the net health outcome of patients with acute chest pain?

The following PICO was used to select literature to inform this review.

Populations
The relevant population of interest is patients with acute chest pain and suspected coronary artery disease (CAD) who are at an intermediate- to low-risk presenting in the emergency setting.

Interventions
The intervention of interest is CCTA.

Comparators
The following tests and practices are currently being used to make decisions about managing acute chest pain and suspected CAD: standard emergency department (ED) care and alternative noninvasive testing including stress tests.

Outcomes
The outcomes of interest are mortality, diagnostic accuracy, and utilization of invasive coronary artery angiography (ICA). The time of interest is in the first few days after admission to an ED and after several years or more after CCTA to evaluate event rates.

Study Selection Criteria
For the evaluation of clinical validity of the CCTA for acute chest pain, studies that meet the following eligibility criteria were considered:

- Reported on the accuracy of the marketed version of the technology (including any algorithms used to calculate scores)
- Included a suitable reference standard
- Patient/sample clinical characteristics were described
- Patient/sample selection criteria were described.

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).

The diagnostic characteristics of CCTA have not been directly assessed in patients in the ED setting. Because patients who test negative on CCTA are discharged from care and their disease status is unknown, there is verification bias, and diagnostic characteristics of CCTA cannot be determined. The diagnostic characteristics of CCTA, previously established in other studies, were assumed to apply to patients in the ED setting and were tested in randomized trials to establish clinical utility.

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, more effective therapy, or avoid unnecessary therapy or 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 randomized controlled trials (RCTs).

Review of evidence
Systematic Reviews
Gongora et al (2018) published a meta-analysis of 10 RCTs (N =6285 patients) comparing CCTA with the standard of care (SOC) in patients with acute chest pain in an ED or inpatient setting.[25] Pooled results suggested that CCTA is associated with more frequent revascularization and ICA, without reducing the risk of adverse cardiac events. Among the limitations of the review was the heterogeneity of SOC across assessed studies, the possibility of publication bias due to the small number of trials available, and the presence of only a few studies that prespecified downstream testing criteria following CCTA results. Tables 1 and 2 summarize review characteristics and results.

Table 1. Characteristics of Systematic Reviews Assessing CCTA in ED Settings

Study	Dates	Trials	Participants	N (Range)	Design	Duration, months
Gongora et al (2018)[25]	2007-2016	10	Acute chest pain in an ED or inpatient setting	6285	RCT	1 to 19

CCTA: coronary computed tomography angiography; ED: emergency department; RCT: randomized controlled trial.

Table 2. Results of Systematic Reviews Comparing CCTA With SOC in ED Settings

Study	ICA (CCTA vs SOC)	Revascularization (CCTA vs SOC)	All-Cause Mortality (CCTA vs SOC)	All-Cause MI (CCTA vs SOC)	All-Cause MACE (CCTA vs SOC)
Gongora et al (2018)[25]					
	Higher incidence in CCTA	Higher incidence in CCTA	No significant between-group difference	No significant between-group difference	No significant between-group difference
RR (95% CI)	1.32 (1.07 to 1.63)	1.77 (1.35 to 2.31)	0.48 (0.17 to 1.36)	0.82 (0.49 to 1.39)	0.98 (0.67 to 1.43)
p	.01	<.001	.17	.47	.92

CCTA: coronary computed tomography angiography; CI: confidence interval; ED: emergency department; ICA: invasive coronary angiography; MACE: major adverse cardiac event; MI: myocardial infarction; RR: relative risk; SOC: standard of care.

Skelly et al (2016), conducted a comparative effectiveness review for the Agency for Healthcare Research and Quality (AHRQ) that assessed noninvasive testing for CAD.[26] Reviewers found that:

- After CCTA, clinical outcomes for patients with an intermediate pretest risk
  - were similar when compared with usual care or functional testing (low to moderate strength of evidence).
  - were similar when compared with single-photon emission computed tomography (low strength of evidence).
- After CCTA, referral for ICA and revascularization
  - was more common than after functional testing (high strength of evidence).
  - was similar compared with single-photon emission computed tomography and usual care (low strength of evidence).
- After CCTA, additional testing in the ED setting
  - was less common compared with usual care (moderate strength of evidence).
  - was more common than after single-photon emission computed tomography (high strength of evidence).
- After CCTA, hospitalization
  - was less common compared with usual care in the ED setting (moderate to low strength of evidence).
  - was similar to functional testing in the outpatient setting (moderate strength of evidence).

Overall, reviewers found no clear differences between strategies for clinical or management outcomes, although CCTA could lead to a higher frequency of referral for ICA and revascularization. Of note, AHRQ archived this report since it is greater than 3 years old. The findings of the report may be used for research purposes, but should not be considered current.

Randomized Controlled Trials

Tables 3 and 4 summarize the characteristics and results of RCTs assessing CCTA procedures conducted in ED settings.

Table 3. Characteristics of RCTs Assessing CCTA in ED Settings

Study; Trial	Countries	Sites	Dates	Participants	Interventions	
					Active	***Comparator(s)***
Smulders et al (2019)[27]; CARMENTA	Netherlands	1	2012-2016	Patients with acute chest pain, normal or inconclusive ECG, and elevated cardiac troponin levels presenting to the ED	70 to CCTA	68 to CMR; 69 to routine clinical care
Levsky et al (2018)[28]	U.S.	1	2011-2016	Patients with acute chest pain or pressure for whom noninvasive testing is requested	201 to CCTA	199 to SE
Hamilton-Craig et al (2014)[29]; CT-COMPARE	Australia	1	2010-2011	Men ≥30 y or women ≥40 y presenting to the ED with acute undifferentiated chest pain	322 to CCTA	240 to SOC (exercise treadmill testing)
Linde et al (2013)[30]; CATCH	Denmark	1	2010-2013	Patients with suspected NSTE-ACS but normal ECG and troponins; discharged within 24 h needing further risk stratification	299 to CCTA (285 had FU available)	301 to SOC (291 had FU available)
Litt et al (2012)[31]; AC RIN-PA	U.S.	5	2009-2011	Symptoms consistent with possible ACS; >30 y; low risk of MI	908 to CCTA	462 to traditional care
Hoffmann et al (2012)[32]; ROMICAT II	U.S.	9	2010-2012	Chest pain or angina equivalent <24 h before ED presentation; 40-74 y; sinus rhythm; warranting further risk stratification	50 to CCTA	499 to SOC
Goldstein et al	U.S.	16	2007-2008	Chest pain <12 h; ≥25 y; low risk of complications; no sign of ischemia at enrollment	361 to CCTA	338 to MPI

Study; Trial	Countries	Sites	Dates	Participants	Interventions	
(2011)[33]; CT-STAT						
Goldstein et al (2007)[34]	U.S.	1	2005	Chest pain or angina-like symptoms <12 h; ≥25 y; low risk of complications	99 to MSCT	98 to SOC

ACS: acute coronary syndrome; CCTA: coronary computed tomography angiography; CMR; cardiovascular magnetic resonance imaging; ECG: electrocardiogram; ED: emergency department; FU: follow-up; MI: myocardial infarction; MPI: myocardial perfusion imaging; MSCT: multislice computed tomography; NSTE-ACS: non-ST-elevation acute coronary syndrome; RCT: randomized controlled trial; SE: stress echocardiography; SOC: standard of care.

Smulders et al (2020) published a 3-arm, prospective, open-label RCT that compared a diagnostic strategy incorporating cardiovascular magnetic resonance imaging (CMR) or CCTA as a gatekeeper for ICA with a control strategy (i.e., routine clinical care) in patients with non-ST-segment elevation myocardial infarction (NSTEMI).[27] Results revealed that CMR or CCTA as an initial test was associated with a reduced proportion of patients referred to ICA during initial hospitalization [87% CMR (p=.001) and 66% CCTA (p<.001) as compared to routine clinical care (100%)]. Significantly fewer ICAs were performed in the CCTA- than CMR-first strategy (p=.004). The reduction in ICA in the CMR- or CCTA-first strategy compared with routine clinical care was persistent after 1 year [88% CMR (p=.003), 70% CCTA (p<.001) and 100% routine clinical care]. Similar clinical outcomes were seen: CMR versus routine, hazard ratio (HR) 0.78; 95% confidence interval (CI), 0.37 to 1.61; CCTA versus routine, HR 0.66; 95% CI, 0.31 to 1.42; and CMR versus CCTA, 1.19; 95% CI, 0.53 to 2.66. In the non-CMR and non-CCTA arms, follow-up CMR and CCTA were performed in 67% and 13% of patients and led to a new diagnosis in 33% and 3%, respectively (p<.001). A follow-up CMR led to a new myocardial infarction (MI) diagnosis in 7 patients.

Levsky et al (2018) published an RCT - in the CCTA arm, 39 (19%) patients were hospitalized, compared with 22 (11%) patients in the stress echocardiography arm, resulting in a difference of 8% (95% CI, 1% to 15%; p=.026).[28] Median length of stay in the hospital was longer for the CCTA arm (58 hours versus 34 hours; p=.002, respectively). There was no significant difference between the CCTA and stress echocardiography arms in terms of MACE (including death); respectively, MACE occurred in 11 CCTA patients and 7 stress echocardiography patients (p=.47) over a median follow-up of 24 months. The median complete initial work-up radiation exposure for the CCTA arm was 6.4 mSv (interquartile range, 5.3 to 7.8 mSv), significantly more than that of stress echocardiography (0 mSv; p<.001). The trial had a number of limitations, including the single-center design and omission of high sensitivity troponin assays.

Hamilton-Craig et al (2014) reported on the diagnostic performance and cost of CT angiography versus stress electrocardiogram (ECG) (CT-COMPARE) trial, which assessed the length of stay and patient costs in 562 patients presenting to the ED with low-to-intermediate risk chest pain who received CCTA or exercise stress testing.[29] Length of stay was significantly reduced in CCTA patients compared with exercise testing patients. Clinical outcomes at 30 days and 12 months did not differ.

Linde et al (2013) reported on the CArdiac cT in the treatment of acute CHest pain (CATCH) trial, which randomized 600 patients to a CCTA-guided strategy or to SOC.[30] For the CCTA-guided strategy, referral for ICA required coronary stenosis greater than 70%. This trial differed in design from the others because patients had been discharged from the ED, and if there was intermediate stenosis (50% to 70%) on CCTA, a stress test was performed.

Litt et al (2012) reported on the American College of Radiology Imaging Network of Pennsylvania (ACRIN-PA) trial, which also evaluated the safety of CCTA in patients in the ED.[31] Although the trial was a randomized comparison with traditional care, the principal outcome was safety after negative CCTA examinations. No patients who had negative CCTA examinations (n=460) died or had a MI within 30 days. Compared with traditional care, patients

in the CCTA group had higher rates of discharge from the ED (49.6% versus 22.7%) and higher rates of detection of coronary disease.
Hoffmann et al (2012) reported on the Rule Out Myocardial Ischemia/Infarction by Computer Assisted Tomography (ROMICAT II) trial, which compared the length of stay with outcomes in 549 patients evaluated using CCTA or usual care.[32] For the 50 patients in the CCTA arm, the mean hospital length of stay was reduced by 7.6 hours, and more patients were discharged directly from the ED (47% versus 12%). There were no undetected coronary syndromes or differences in adverse events at 28 days. However, in the CCTA arm, there was more subsequent diagnostic testing and higher cumulative radiation exposure.

Goldstein et al (2011) reported on the Coronary Computed Tomography for Systematic Triage of Acute Chest Pain Patients to Treatment (CT-STAT) trial, which evaluated a similar sample of 699 patients.[33] Over a 6-month follow-up, there were no deaths in either arm; there were 2 cardiac events in the CCTA arm and 1 in the perfusion imaging arm. A second noninvasive test was obtained more often after CCTA (10.2% vs 2.1%), but cumulative radiation exposure in the CCTA arm (using retrospective gating) was significantly lower (mean, 11.5 mSv vs 12.8 mSv).
Goldstein et al (2007) randomized 197 patients without evidence of acute coronary syndrome (ACS) to CCTA (n=99) or usual care (n=98).[34] Over a 6-month follow-up, no cardiac events occurred in either arm. Diagnosis was achieved more quickly after CCTA.

Table 4. Summary of Results of RCTs Assessing CCTA in ED Settings

Study	ICA (CCTA vs Control), %	Diagnostic Accuracy (CCTA vs Control), %[a]	MI in Negative CCTA Arm	Median Diagnostic Time (CCTA vs Control), hr[b]	FU, mo
Smulders et al (2019)[27]	66 vs 100	NR	7	NR	1 and 12
Levsky et al (2018)[28]	NR	NR	NR	5.4 vs 4.7[d]	1 and 12
Hamilton-Craig et al (2014)[29]	9.0 vs 4.2	94%/99% vs 83%/91%[c]	0	13.5 vs 20.7[d]	1 and 12
Linde et al (2013)[30]	17 vs 12	71 vs 36[e]	0	NR	4
Litt et al (2012)[31]	5.1 vs 4.2	NR	0	18.0 vs 24.8	1
Hoffmann et al (2012)[32]	12.0 vs 21.0	NR	0	5.8 vs 21.0	1
Goldstein et al (2011)[33]	6.6 vs 6.2	76.9 vs 54.5	0	2.9 vs 6.2	6
Goldstein et al (2007)[34]	12.1 vs 7.1	88.9 vs 98.0	0	3.4 vs 15.0	6

CCTA: coronary computed tomography angiography; ED: emergency department; FU: follow-up; ICA: invasive coronary angiography; MI: myocardial infarction; NR: not reported; RCT: randomized controlled trial.
[a] Confirmed with angiographic and clinical results.
[b] Time from randomization to definitive diagnosis.
[c] Reporting the sensitivity/specificity for CCTA versus exercise stress electrocardiogram for ACS with stenosis >70%.
[d] Refers to length of stay rather than time to diagnosis.
[e] Positive predictive value for CCTA versus standard of care.
The purpose of the limitations tables (Tables 5 and 6) is to display notable limitations identified in each study. This information is synthesized as a summary of the body of evidence following each table and provides the conclusions on the sufficiency of the evidence supporting the position statement.

Table 5. Study Relevance Limitations for RCTs Assessing CCTA in ED Settings

Study	Population[a]	Intervention[b]	Comparator[c]	Outcomes[d]	Duration of Follow-Up[e]
Smulders et al (2019)[27]	2. Patients with a history of myocardial disease and/or severe noncardiac comorbidities				

Study	Population[a]	Intervention[b]	Comparator[c]	Outcomes[d]	Duration of Follow-Up[e]
	were excluded				
Levsky et al (2018)[28]					
Hamilton-Craig et al (2014)[29]	4. Limited applicability to men <30 y and women <40 y				
Linde et al (2013)[30]					
Litt et al (2012)[31]	4. Limited to patients 40 to 74 y; may not be relevant for younger or older individuals				
Hoffmann et al (2012)[32]					
Goldstein et al (2011)[33]					
Goldstein et al (2007)[34]		3. Unequal rates of ICA/revascularization	3. Unequal rates of ICA/revascularization		

The study limitations stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.
CCTA: coronary computed tomography angiography; ED: emergency department; ICA: invasive coronary angiography; RCT: randomized controlled trial.
[a] Population key: 1. Intended use population unclear; 2. Clinical context is unclear; 3. Study population is unclear; 4. Study population not representative of intended use.
[b] Intervention key: 1. Classification thresholds not defined; 2. Version used unclear; 3. Not intervention of interest.
[c] Comparator key: 1. Classification thresholds not defined; 2. Not compared to credible reference standard; 3. Not compared to other tests in use for same purpose.
[d] Outcomes key: 1. Study does not directly assess a key health outcome; 2. Evidence chain or decision model not explicated; 3. Key clinical validity outcomes not reported (sensitivity, specificity, and predictive values); 4. Reclassification of diagnostic or risk categories not reported; 5. Adverse events of the test not described (excluding minor discomforts and inconvenience of venipuncture or noninvasive tests).
[e] Follow-Up key: 1. Follow-up duration not sufficient with respect to natural history of disease (true-positives, true-negatives, false-positives, false-negatives cannot be determined).

Table 6. Study Design and Conduct Limitations of RCTs Assessing CCTA in ED Settings

Study	Allocation[a]	Blinding[b]	Selective Reporting[c]	Data Completeness[d]	Power[e]	Statistical[f]
Smulders et al (2019)[27]		1, 2.			3. Sample size calculation based on an estimated 75% ICA referral rate; however, all patients (100%) in the routine clinical care arm eventually underwent ICA	
Levsky et al (2018)[28]					2. Not powered to detect differences in MACE	

Study	Allocation[a]	Blinding[b]	Selective Reporting[c]	Data Completeness[d]	Power[e]	Statistical[f]
Hamilton-Craig et al (2014)[29]					2. Not powered to compare outcomes	
Linde et al (2013)[30]		1. Only patients and clinicians blinded to treatment allocation			2. Not powered to detect differences in secondary outcomes (intermediate cardiac events)	
Litt et al (2012)[31]					2. Due to low incidence of events, not powered for primary outcome (safety)	
Hoffmann et al (2012)[32]		1. No blinding to treatment				
Goldstein et al (2011)[33]				1. 10.3% of patients lost to follow-up	2. Not powered for secondary outcome (safety)	
Goldstein et al (2007)[34]					1. Power calculations not reported	4. No assessment of alternative noninvasive tests

The study limitations stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.
CCTA: coronary computed tomography angiography; ED: emergency department; ICA: invasive coronary angiography; MACE: major adverse cardiac event; RCT: randomized controlled trial:
[a] Allocation key: 1. Participants not randomly allocated; 2. Allocation not concealed; 3. Allocation concealment unclear; 4. Inadequate control for selection bias.
[b] Blinding key: 1. Not blinded to treatment assignment; 2. Not blinded outcome assessment; 3. Outcome assessed by treating physician.
[c] Selective Reporting key: 1. Not registered; 2. Evidence of selective reporting; 3. Evidence of selective publication.
[d] Data Completeness key: 1. High loss to follow-up or missing data; 2. Inadequate handling of missing data; 3. High number of crossovers; 4. Inadequate handling of crossovers; 5. Inappropriate exclusions; 6. Not intent to treat analysis (per protocol for noninferiority trials).
[e] Power key: 1. Power calculations not reported; 2. Power not calculated for primary outcome; 3. Power not based on clinically important difference.
[f] Statistical key: 1. Analysis is not appropriate for outcome type: (a) continuous; (b) binary; (c) time to event; 2. Analysis is not appropriate for multiple observations per patient; 3. Confidence intervals and/or p values not reported; 4. Comparative treatment effects not calculated.

Long-Term Follow-Up Studies

Results from long-term follow-up studies are tabulated in Table 7.

Table 7. Results of Follow-Up Studies of RCTs

Study	Initial Study Design (Trial)	Follow-Up Duration	Results
Linde et al (2015)[35]	RCT (CATCH)	18.7 mo (IQR, 16.8 to 20.1)	In the CCTA group (n=285), there were 5 MACE vs 14 MACE in the SOC group (n=291) (HR=0.36; 95% CI, 0.16 to 0.95; p=.04)
Schlett et al (2011)[36]	RCT (ROMICAT)	2 y	Of 333 patients without CAD detected by CCTA, none had a MACE event during follow-up

CAD: coronary artery disease; CCTA: coronary computed tomography angiography; CI: confidence interval; HR: hazard ratio; IQR: interquartile range; MACE: major adverse cardiac event; RCT: randomized controlled trial; SOC: standard of care.

Nonrandomized Studies

Durand et al (2017) compared the diagnostic performance of dobutamine-stress echocardiography (DSE) with CCTA in 217 adults.[37] Patients had normal measurements of troponin I or T, and electrocardiography results. All patients received DSE and CCTA, with only 75 (34.6%) patients receiving ICA, which served as the reference test. The primary endpoint was the diagnostic accuracy of the tests for detecting coronary stenosis greater than 50%. Forty-nine (22.6%) patients had a positive CCTA while 33 (15.2%) patients had a positive DSE. A negative CCTA result was reported in 144 (66.4%) patients, and 146 (67.3%) had a negative DSE result. Overall, CCTA was more sensitive than DSE in detecting CAD, while specificity was similar between tests. At 6 months, no patients had died or received a diagnosis of MI, but 1 patient presented with ACS whose diagnosis was initially missed. No limitations were identified. Tables 8 and 9 summarize the trial characteristics and results.

Table 8. Key Nonrandomized Trials Assessing CCTA in ED Settings

Study	Study Type	Country	Dates	Participants	Treatment	Comparator	Follow-Up
Durand et al (2017)[37]	Prospective head-to-head multicenter	France	NR	Adults treated at the ED for chest pain <24 h after symptom onset	CCTA	DSE	6 mo

CCTA: coronary computed tomography angiography; DSE: dobutamine-stress echocardiography; ED: emergency department; NR: not reported.

Table 9. Results of Key Nonrandomized Trials Assessing CCTA in ED Settings

Study	Diagnostic Accuracy		Incidence of MI	ICA, n (%)[b]
	CCTA[a]	*DSE*[a]		
Durand et al (2017)[37]				
N	217	217	None during FU	75 (34.6)
Sensitivity, %	96.9	51.6		
Specificity, %	48.3	46.7		
PLR (95% CI)	2.09 (1.36 to 3.11)	1.03 (0.62 to 1.72)		
NLR (95% CI)	0.07 (0.01 to 0.52)	1.10 (0.63 to 1.96)		

CCTA: coronary computed tomography angiography; CI: confidence interval; DSE: dobutamine-stress echocardiography; ED: emergency department; FU: follow-up; ICA: invasive coronary angiography; MI: myocardial infarction; NLR: negative likelihood ratio; PLR: positive likelihood ratio.
[a] Of detected coronary stenosis >50%.
[b] Number of patients who received ICA.

Section Summary: Acute Chest Pain Presenting in the Emergency Setting

The high negative predictive value of CCTA in patients presenting to the ED with chest pain permits ruling out coronary disease with high accuracy. The efficiency of the workup is improved because patients are safely and quickly discharged from the ED with no adverse outcomes among patients with negative CCTA examinations.

Other important outcomes that require consideration when comparing technologies include ICA rates, use of a second noninvasive test, radiation exposure, and follow-up of any incidental findings. Some studies have shown that subsequent invasive testing is more frequent in patients who received CCTA. Studies have differed over which treatment strategies result in higher overall radiation exposure. Incidental findings after CCTA are common and lead to further testing but the impact of these findings on subsequent health outcomes is uncertain.

Patients With Stable Chest Pain and Suspected Coronary Artery Disease

Before the use of CCTA, the initial noninvasive test in a diagnostic strategy was always a functional test. Current practice guidelines recommend a noninvasive test be performed in patients with an intermediate risk of CAD. The choice of the functional test is based on clinical factors such as the predicted risk of disease, ECG interpretability, and ability to exercise. When the disease is detected, treatment alternatives include medical therapy or revascularization (percutaneous coronary intervention or coronary artery bypass graft surgery). If revascularization is indicated, patients undergo ICA to confirm the presence of stenosis. Which approach to adopt is based on the extent of anatomic disease, symptom severity, evidence of ischemia from functional testing, and, more recently, fractional flow reserve obtained during invasive angiography. Many studies have shown that only a subset of anatomically defined coronary lesions are clinically significant and benefit from revascularization. Other studies have shown only limited benefits for treating coronary stenoses in stable patients. Thus an assessment of the diagnostic characteristics of CCTA alone is insufficient to establish clinical utility. A difficulty in evaluating a noninvasive diagnostic test for CAD is that patient outcomes depend not only on test results but also on the management and treatment strategy. The most convincing evidence of clinical utility compares outcomes after anatomic-first (CCTA) and functional-first (e.g., perfusion imaging, stress echocardiography) strategies.

Relevant studies reviewed here include those comparing the diagnostic performance of CCTA with angiography, studies of outcomes of patients undergoing CCTA versus alternative tests, and studies of incidental findings and radiation exposure.

Clinical Context and Test Purpose
The purpose of CCTA in patients with stable chest pain and suspected CAD is to diagnose coronary artery obstruction and guide treatment decisions.

The question addressed in this evidence review is: Does the use of CCTA improve the net health outcome of patients with stable chest pain?

The following PICO was used to select literature to inform this review.

Populations
The relevant population of interest is patients with stable chest pain and suspected CAD who are at an intermediate- risk and meet guideline criteria for noninvasive testing.

Interventions
The intervention of interest is CCTA.

Comparators
The following tests and practices are currently being used to make decisions about managing stable chest pain: noninvasive testing including exercise electrocardiography, myocardial perfusion imaging (MPI), stress echocardiography, and standard care.

Outcomes
The outcomes of interest are mortality, sensitivity and specificity, MI, hospitalization, and utilization of ICA. The time of interest is in the short-term to evaluate follow-up procedures after imaging and for several years or more after CCTA to determine event rates.

Study Selection Criteria
For the evaluation of clinical validity of the CCTA for stable chest pain, studies that meet the following eligibility criteria were considered:

- Reported on the accuracy of the marketed version of the technology (including any algorithms used to calculate scores)
- Included a suitable reference standard
- Patient/sample clinical characteristics were described
- Patient/sample selection criteria were described.

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).

Review of evidence

There is a fairly large body of evidence evaluating the diagnostic characteristics of CCTA for identifying coronary lesions. The best estimate of the diagnostic characteristics of CCTA can be obtained from recent meta-analyses, systematic reviews, and guideline reports. Table 10 shows ranges of sensitivity and specificity for functional noninvasive tests as summarized in collaborative medical association guidelines for the diagnosis and management of stable angina by Fihn et al (2012).[38] Sensitivities tended to range between 70% and 97%, depending on the test and study, and specificities ranged between 70% and 90%.

Characteristics and results of reviews are summarized in Tables 11 and 12. For CCTA, estimates of sensitivity from various systematic reviews are considerably higher (Table 12).

Table 10. Sensitivity and Specificity Estimates for Functional Noninvasive Tests From Guidelines

Noninvasive Test	Sensitivity (Range or Single Estimates), %	Specificity (Range or Single Estimates), %
Exercise electrocardiography	61	70 to 77
Pharmacologic stress echocardiography	85 to 90	79 to 90
Exercise stress echocardiography	70 to 85	77 to 89
Exercise myocardial perfusion imaging	82 to 88	70 to 88
Pharmacologic stress myocardial perfusion imaging	88 to 91	75 to 90
Coronary computed tomography angiography	93 to 97	80 to 90

Adapted from Fihn et al (2012).[38]

Table 11. SR & MA Characteristics of Clinical Validity for CCTA in Stable Chest Pain and Suspected CAD

Study	Study Population	Design[a]	Reference Standard	Threshold for Positive Index Test	Timing of Reference and Index Tests	Blinding of Assessors	Comment
Haase et al (2019)[39]	Individuals with a clinical indication for coronary angiography due to suspected CAD because of stable chest pain. Individual patient data sufficient to calculate pre-test clinical risk. Studies comparing CCTA with ICA. N = 533,265 prospective diagnostic accuracy studies	MA	ICA	CCTA: • Obstructive CAD: ≥ 50% stenosis Pre-test Clinical Risk: • CAD Consortium prediction tool	NR	NR	Acceptable thresholds for index and reference tests were unclear. Calculation of pre-test clinical risk assessment not clearly described. Timing of tests not reported.
Nielsen et al (2014)[40]	Studies examining the diagnostic	MA	ICA	CCTA: NR	NR	NR	Details on blinding and timing were

Study	Study Population	Design[a]	Reference Standard	Threshold for Positive Index Test	Timing of Reference and Index Tests	Blinding of Assessors	Comment
	accuracy of CCTA vs functional testing in patients suspected of stable CAD where ICA is used as a reference standard. N = 157,517 diagnostic accuracy and nonrandomized studies						limited. Quality assessment results for bias risk in diagnostic accuracy studies was predominantly low.
Ollendorf et al (2011)[41]	Diagnostic accuracy studies of CCTA vs ICA as the reference standard. 42 diagnostic accuracy studies	MA	ICA	CCTA: NR	NR	Blinded review of CCTA and ICA	
Health Quality Ontario (2010)[42]	Diagnostic accuracy studies of CCTA in suspected CAD with ICA as reference standard. Individuals with intermediate pre-test probability of CAD. N = 1178 studies	MA	ICA	CCTA: • CAD: ≥ 50% stenosis	NR	NR	Analysis is limited by significant heterogeneity between studies.

CAD: coronary artery disease; CCTA: coronary computed tomography angiography; ICA: invasive coronary angiography; MA: meta-analysis; NR: not reported; SR: systematic review.
[1] Key eligibility criteria.

Table 12. SR & MA Results for CCTA in Stable Chest Pain and Suspected CAD

Study; Subgroup	Clinical Validity, % (95% CI)			
	Sensitivity	***Specificity***	***PPV***	***NPV***
Haase et al (2019) (COME-CCT); Overall[39]	95.2 (92.6 to 96.9)	79.2 (74.9 to 82.9)	75.6 (NR)	86.3 (NR)
Haase et al (2019) (COME-CCT); Pre-test Clinical Risk Subgroup[39] 7%	NR	NR	50.9 (43.3 to 57.7)	97.8 (96.4 to 98.7)
15%	NR	NR	55.8 (48.6 to 62.3)	97.1 (95.4 to 98.2)
50%	NR	NR	75.4 (70.5 to 79.5)	90.9 (87.5 to 93.4)
67%	NR	NR	82.7 (78.3 to 86.2)	85.0 (80.2 to 88.9)
Nielsen et al (2014)[40]	98 (93 to 99)	82 (63 to 93)	85 (71 to 93.5)	97.5 (87 to 99)
Ollendorf et al (2011)[41]	98 (96 to 99)	85 (81 to 89)	NR	NR

Health Quality Ontario (2010)[42]	96.1 (94 to 98.3)	81.5 (73.0 to 89.9)	NR	NR

CAD: coronary artery disease; CCTA: coronary computed tomography angiography; CI: confidence interval; MA: meta-analysis; NPV: negative predictive value; NR: not reported; PPV: positive predictive value; SR: systematic review.

Clinically Useful

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

Foy et al (2017) conducted a systematic review comparing CCTA with functional stress testing for patients with suspected CAD and stable or acute chest pain.[43] In the CCTA arm, there were 10,315 patients, and in the functional stress testing arm, there were 9,777 patients; both CCTA and functional stress testing strategies varied among the 13 trials. Overall mortality and cardiac hospitalization did not differ between CCTA and functional stress testing groups. There were fewer cases of MI in the CCTA group than in the functional stress testing group; however, the incidence of ICA and revascularization were higher in the CCTA group. Coronary computed tomographic angiography was associated with an increase in new diagnoses of CAD as well as increased prescription of aspirin and statin therapy. All trials reported a lack of blinding, both of patients and personnel, and the overall quality of evidence was moderate, despite a high-risk of bias in several studies included. Additional limitations included the lack of available patient-level data, the absence of assessment of time to hospital discharge, and differences in radiation exposure. Tables 15 and 16 summarize review characteristics and results.

Table 15. Characteristics of Systematic Reviews Assessing CCTA for Stable Chest Pain

Study	Dates	Trials	Participants	N (Range)	Design	Duration
Foy et al (2017)[43]	2000-2016	13	Patients with suspected CAD	20,092 (CCTA arm: n=10,315; functional stress testing arm: n=9,777)	RCT	NR

CAD: coronary artery disease; CCTA: coronary computed tomography angiography; NR: not reported; RCT: randomized controlled trial.

Table 16. Results of Systematic Reviews Assessing CCTA for Stable Chest Pain

Study	Incidence of ICA, %	Revascularization, %	Adverse Events, %	New Diagnoses of CAD, %	Medication Use, %[a]
Foy et al (2017)[43]					
CCTA vs Functional stress testing	11.7 vs 9.1	7.2 vs 9.1	• Mortality: 1.0 vs 1.1 • Hospitalization: 2.7 vs 2.7 • MI: 0.7 vs 1.1	18.3 vs 8.3	Aspirin: 21.6 vs 8.2 Statins: 20.0 vs 7.3
RR (95% CI)	1.33 (1.12 to 1.59)	1.86 (1.43 to 2.43)	• Mortality: 0.93 (0.71 to 1.21) • Hospitalization: 0.98 (0.79 to 1.21) • MI: 0.71 (0.53 to 0.96)	2.80 (2.03 to 3.87)	Aspirin: 2.21 (1.21 to 4.04) Statins: 2.03 (1.09 to 3.76)

CAD: coronary artery disease; CCTA: coronary computed tomography angiography; CI: confidence interval; ICA: invasive coronary angiography; MI: myocardial infarction; RR: relative risk.
[a] Proportion of patients who experienced a significant increase in medication use.

Randomized Controlled Trials

For patients at intermediate risk of CAD, 7 major RCTs were identified by comparing outcomes after a CCTA strategy with outcomes after other noninvasive testing strategies. Tables 17 and 18 summarize trial characteristics and results.

Table 17. Characteristics of Key RCTs Assessing CCTA in Stable Chest Pain

Study; Trial	Countries	Sites	Dates	Participants	Interventions	
					Active	***Comparator***
Stillman et al (2020)[44]; RESCUE	U.S.	44	2011-2013	Patients with stable angina and suspected CAD	518 to CCTA	532 to SPECT-MPI
Newby et al (2019)[45]; SCOT-HEART	U.K.	12	2010-2014	Patients referred for assessment of angina due to suspected CHD	2073 to standard of care plus CCTA	2073 to standard of care
Chang et al (2019)[46]; CONSERVE	Various	22	2012-2016	Patients with suspected CAD referred to nonemergent ICA	823 to selective referral strategy with initial CCTA	808 to direct referral strategy with initial ICA
Rudzinski et al (2018)[47]; CAT-CAD	Poland	1	2015-2016	Patients with stable angina and suspected CAD	60 to CCTA	60 to ICA
Douglas et al (2015)[48]; PROMISE	U.S.	193	2010-2013	Symptomatic outpatients without diagnosed CAD	4996 to anatomic testing strategy with CCTA	5007 to functional testing strategy
SCOT-HEART Investigators (2015)[49]; SCOT-HEART	U.K.	12	2010-2014	Patients referred for assessment of angina due to suspected CHD	2073 to standard of care plus CCTA	2073 to standard of care
McKavanagh et al (2015)[50]; CAPP	U.K.	NR	2010-2011	Patients with symptoms of stable chest pain	250 to EST	250 to cardiac CT

CAD: coronary artery disease; CHD: coronary heart disease; CT: computed tomography; CCTA: coronary computed tomography angiography; EST: exercise stress electrocardiogram test; ICA: invasive coronary angiography; NR: not reported; RCT: randomized controlled trial; SPECT-MPI: single photon emission computed tomography
myocardial perfusion imaging.

Stillman et al (2020) reported results from the Randomized Evaluation of Patients with Stable Angina Comparing Utilization of Noninvasive Examinations (RESCUE) trial, which randomized 1050 patients with stable angina and suspected CAD to CCTA or single photon emission CT myocardial perfusion imaging (SPECT-MPI) to direct patients to optimal medical therapy alone or optimal medical therapy with revascularization.[44] The primary endpoint was first MACE (cardiac death or MI), or revascularization. Over a mean follow-up period of 16.2 months, there was a similar rate of MACE or revascularization in patients with CCTA compared to SPECT-MPI (p=.19). The authors did not report separate rates of MACE and revascularization.

Newby et al (2019) published updated 5-year outcomes from the CT coronary angiography in patients with suspected angina due to coronary heart disease (SCOT-HEART) trial. A significantly lower rate of death or nonfatal MI was found for patients undergoing CCTA with the SOC. Coronary computed tomographic angiography was not found to increase rates of revascularization or subsequent utilization of ICA at this time point.[45] The authors of a post-hoc analysis of the 5 year SCOT-HEART data concluded that "the beneficial effect of CCTA on

outcomes is consistent across subgroups with plausible underlying mechanisms" and that CCTA "improves CHD [coronary heart disease] outcomes by enabling better targeting of preventative treatments to those with CAD."[51]

Chang et al (2019) randomized 1611 patients to different referral strategies, where initial assessment for CAD was performed by CCTA or ICA. Downstream clinical decision-making and testing were left to the discretion of treating physicians. The primary outcome measure was noninferiority of CCTA in regard to MACE.[46]

Rudzinski et al (2018) reported on results from the Coronary Artery Computed Tomography as the First-Choice Imaging Diagnostic in Patients With High Pre-Test Probability of Coronary Artery Disease (CAT-CAD) trial, which randomized 120 patients with suspected CAD to undergo CCTA versus direct ICA. Outcomes were evaluated during the diagnostic and therapeutic periods. Evaluation with CCTA was found to reduce the total number of ICAs performed.[47]
Douglas et al (2015) reported on the PROspective Multicenter Imaging Study for Evaluation of Chest Pain (PROMISE) trial, which randomized 10,003 patients to CCTA or exercise electrocardiography, nuclear stress testing, or stress echocardiography (as determined by physician preference) as the initial diagnostic evaluation.[48] Coronary computed tomographic angiography also did not meet prespecified noninferiority criteria compared with alternative testing. Some clinical outcomes assessed at 12 months favored CCTA, but the differences were nonsignificant. Coronary catheterization and revascularization rates were higher in the CCTA group. In a further prespecified analysis of PROMISE trial data, Hoffmann et al (2017) found that there was no difference in event rates (death, MI, or angina) between the groups at a median of 26 months follow-up.[52] However, CCTA had better discriminatory ability than functional testing to predict events (e.g., in categories of normal, mildly abnormal, moderately abnormal, and severely abnormal) in patients who had nonobstructive CAD (p=.04). When the Framingham Risk Score was added to functional testing results, there was no significant difference in prognostic capability between the approaches (p=.29).

In the SCOT-HEART trial (2015), investigators randomized 4146 patients to CCTA plus SOC or SOC alone. The primary endpoint was the change in the proportion of patients with a more certain diagnosis (presence or absence) of angina pectoris.[49] Secondary outcomes included death, MI, revascularization procedures, and hospitalizations for chest pain. Analysis of the primary outcome showed that patients who underwent CCTA had an increase in the certainty of their diagnosis relative to those in usual care (relative risk, 1.79; 95% CI, 1.62 to 1.96). Williams et al (2017) reported on symptoms and quality of life for participants in the SCOT-HEART trial.[53] Symptoms improved in both groups; however, improvements in symptoms and quality of life at 6 months were lower in patients in the CCTA arm than the functional testing arm. This outcome was due primarily to patients who were diagnosed with moderate CAD or had a new prescription of preventative therapy compared with patients diagnosed with normal coronary arteries or who had their preventative therapy discontinued.

In the comparison of cardiac computerized tomography and exercise stress electrocardiogram test for the investigation of stable chest pain (CAPP) trial, McKavanagh et al (2015) randomized 500 patients with stable chest pain to CCTA or exercise stress testing.[50] The primary outcome was the change difference in scores of Seattle Angina Questionnaire domains at 3 months. Patients were also followed for further diagnostic tests and management. In the CCTA arm, 15.2% of subjects underwent revascularization. In the exercise stress testing arm, 7.7% underwent revascularization. For the primary outcome, angina stability and quality of life showed significantly greater improvement in the CCTA arm than in the exercise stress testing arm.

Table 18. Results of Key RCTs Assessing CCTA in Stable Chest Pain

Study	Death or Nonfatal Myocardial Infarction	Incidence of ICA	Revascularization	Normal Findings on ICA	Angina Stability	Hospitalization
Stillman et al (2020)[44]		NR	NR	NR	NR	NR
CCTA, %	Negative test (1.2%); Positive test (20.5%)*					
SPECT-MPI, %	Negative test (3.2%); Positive test (34.8%)*					
HR	1.03 (0.61 to 1.75)*					
p	.19*					
Newby et al (2019)[45]				NR	NR	NR
CCTA + standard care, n (%)	48 (2.3)	491 (23.7)	279 (13.5)			
Standard care, n (%)	81 (3.9)	502 (24.2)	267 (12.9)			
HR at 5 yr (95% CI)	0.59 (0.41 to 0.84)	1.00 (0.88 to 1.13)	1.07 (0.91 to 1.27)			
p	.004	NR	NR			
Chang et al (2019)[46]					NR	
Selective Referral to CCTA, n (%)	36 (4.6)	179 (23%)	98 (13%)	24.6%		33 (4.2%)
Direct Referral to ICA, n (%)	33 (4.6)	719 (89%)	127 (18%)	61.1%		31 (4.3%)
HR (95% CI)	0.99 (0.66 to 1.47)	NR	NR			NR
p	0.990.026 (1-sided noninferiority)	<.001	.007	<.001		NR
Rudzinski et al (2018)[47]			NR		NR	
CCTA, n	0	21		5		25
ICA, n	0	59		42		73
p		<.0001		<.0001		<.0001
Douglas et al (2015)[48]		NR	NR	NR	NR	
CCTA group	104					61
Functional testing group	112					41
HR (95% CI)	0.88 (0.67 to 1.15)					
p	.35					
SCOT-HEART Investigators (2015)[49]		NR	NR	NR	NR	
CCTA, n (%)	26					511 (12.3)
Standard care, n (%)	42					247 (11.9)
HR (95% CI)	0.616 (0.378 to 1.006)					0.928 (0.780 to 1.104)

Study	Death or Nonfatal Myocardial Infarction	Incidence of ICA	Revascularization	Normal Findings on ICA	Angina Stability	Hospitalization
p	.527					.399
McKavanagh et al (2015)[50]	NR	NR	NR	NR		NR
MD at 3 mo (95% CI)					-11.1 (-17.4 to -.4.8)	
p						
MD at 12 mo (95% CI)					-6.8 (-12.8 to -0.7)	
p					.028	

*In the Stillman et al (2020) study, the primary endpoint included cardiovascular death, nonfatal myocardial infarction, or revascularization.
CI: confidence interval; CCTA: coronary computed tomography angiography; HR: hazard ratio; ICA: invasive coronary angiography; MD: mean difference; NR: not reported; RCT: randomized controlled trial.
Tables 19 and 20 display notable relevance, design, and conduct limitations identified in each trial.

Table 19. Study Relevance Limitations of RCTs Assessing CCTA in Stable Chest Pain

Study	Population[a]	Intervention[b]	Comparator[c]	Outcomes[d]	Duration of Follow-Up[e]
Stillman et al (2020)[44]				1. Key health outcomes not addressed	2. Not sufficient duration for harms
Newby et al (2019)[45]	4. Patients >75 y excluded				
Chang et al (2019)[46]	4. Population included >84% Asian patients in each treatment arm				
Rudzinski et al (2018)[47]					2. Not sufficient duration for harms
Douglas et al (2015)[48]				1. Test performance and utility not addressed	
SCOT-HEART Investigators (2015)[49]	4. Patients >75 y excluded				
McKavanagh et al (2015)[50]	4. Low number of diabetics included due to exclusion criteria		1, 2. Noted difficulty in contrasting the results of anatomic and functional tests		

The study limitations stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.
CCTA: coronary computed tomography angiography; RCT: randomized controlled trial.
[a] Population key: 1. Intended use population unclear; 2. Clinical context is unclear; 3. Study population is unclear; 4. Study population not representative of intended use.
[b] Intervention key: 1. Not clearly defined; 2. Version used unclear; 3. Delivery not similar intensity as comparator; 4.Not the intervention of interest.
[c] Comparator key: 1. Not clearly defined; 2. Not standard or optimal; 3. Delivery not similar intensity as intervention; 4. Not delivered effectively.
[d] Outcomes key: 1. Key health outcomes not addressed; 2. Physiologic measures, not validated surrogates;

3. No CONSORT reporting of harms; 4. Not establish and validated measurements; 5. Clinical significant difference not prespecified; 6. Clinical significant difference not supported.
[e] Follow-Up key: 1. Not sufficient duration for benefit; 2. Not sufficient duration for harms.

Table 20. Study Design and Conduct Limitations of RCTs Assessing CCTA for Stable Chest Pain

Study	Allocation[a]	Blinding[b]	Selective Reporting[c]	Data Completeness[d]	Power[e]	Statistical[f]
Stillman et al (2020)[44]		1. Not blinded to treatment assignment.		1. High loss to follow-up or missing data (ie, low adherence)		
Newby et al (2019)[45]		1-3. Treatments and outcomes not blinded and potential bias among attending clinicians was present.				
Chang et al (2019)[46]	2. Allocation not concealed.	1. Not blinded to treatment assignment.		1. High loss to follow-up or missing data.		
Rudzinski et al (2018)[47]	2. Allocation not concealed.			2. Unclear handling of missing data.	1. Power calculation not reported.	3. Confidence intervals not reported.
Douglas et al (2015)[48]						
SCOT-HEART Investigators (2015)[49]		1-3. Treatments and outcomes not blinded and potential bias among attending clinicians was present.				
McKavanagh et al (2015)[50]					3. Study not powered to evaluate prognosis or adverse CAD events	

The study limitations stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.
CAD: coronary artery disease; CCTA: coronary computed tomography angiography; RCT: randomized controlled trial.
[a] Allocation key: 1. Participants not randomly allocated; 2. Allocation not concealed; 3. Allocation concealment unclear; 4. Inadequate control for selection bias.
[b] Blinding key: 1. Not blinded to treatment assignment; 2. Not blinded outcome assessment; 3. Outcome assessed by treating physician.
[c] Selective Reporting key: 1. Not registered; 2. Evidence of selective reporting; 3. Evidence of selective publication.
d Data Completeness key: 1. High loss to follow-up or missing data; 2. Inadequate handling of missing data; 3. High number of crossovers; 4. Inadequate handling of crossovers; 5. Inappropriate exclusions; 6. Not intent to treat analysis (per protocol for noninferiority trials).
[e] Power key: 1. Power calculations not reported; 2. Power not calculated for primary outcome; 3. Power not based on clinically important difference.

[f] Statistical key: 1. Analysis is not appropriate for outcome type: (a) continuous; (b) binary; (c) time to event; 2. Analysis is not appropriate for multiple observations per patient; 3. Confidence intervals and/or p values not reported; 4. Comparative treatment effects not calculated.

Section Summary: Stable Angina and Suspected Coronary Artery Disease
A number of studies have evaluated the diagnostic accuracy of CCTA for diagnosing CAD in an outpatient population. In general, these studies have reported high sensitivity and specificity, although there is some variability in these parameters across studies. Meta-analyses of these studies have shown that, for the detection of anatomic disease, CCTA has a sensitivity greater than 95%, which is superior to all other functional noninvasive tests. Specificity is at least as good as other noninvasive tests. However, the link between improved diagnosis and health outcomes is not as clear, and thus outcome studies are necessary to demonstrate the clinical utility of CCTA.

Direct clinical trial evidence comparing CCTA and other strategies in the diagnostic management of stable patients with suspected CAD has not demonstrated the superiority of CCTA in any of the single clinical trials. Recent clinical trials have demonstrated similar or lower rates of ICA and subsequent revascularization procedures with CCTA versus standard care or ICA, respectively. An important problem when interpreting the clinical trials is that the comparator strategies differ: in the PROMISE and CAPP trials, CCTA was compared with an alternative noninvasive test; in other studies, CCTA supplemented usual care (which may or may not have included a noninvasive test). These trial design differences are likely to reflect how CCTA is used in clinical practice-either as a substitute for another noninvasive test or as an adjunct to other noninvasive tests. The PROMISE trial explicitly compared CCTA with an alternative functional test as the initial diagnostic test. Although the trial did not show the superiority of CCTA and did not meet prespecified criteria for noninferiority, an examination of some secondary clinical outcomes supports a conclusion of "at least" noninferiority. The results of the other randomized trials are consistent with the noninferiority of CCTA compared with other established noninvasive tests and ICA. Thus, the randomized studies suggest that outcomes of patients are likely to be similar to CCTA versus other noninvasive tests.

Suspected Anomalous Coronary Arteries
Anomalous coronary arteries are an uncommon finding during angiography, occurring in approximately 1% of coronary angiograms completed for evaluation of chest pain. However, these congenital anomalies can be clinically important depending on the course of the anomalous arteries.

Clinical Context and Test Purpose
The purpose of CCTA in patients who have suspected anomalous coronary arteries is to provide a treatment option that is an alternative to or an improvement on existing therapies.
The question addressed in this evidence review is: Does the use of CCTA improve the net health outcome in patients with suspected anomalous coronary arteries?

The following PICO was used to select literature to inform this review.

Populations
The relevant population of interest is individuals with suspected anomalous coronary arteries.

Interventions
The therapy being considered is CCTA.

Comparators
The following practice is currently being used to make decisions about managing suspected anomalous coronary arteries: SOC without CCTA.

Outcomes
The general outcomes of interest are overall survival , test accuracy, morbid events, and resource utilization. The time of interest is in the short-term to evaluate follow-up procedures after imaging and for several years or more after CCTA to determine event rates.

Study Selection Criteria
For the evaluation of clinical validity of the CCTA for anomalous coronary arteries, studies that meet the following eligibility criteria w
ere considered:

- Reported on the accuracy of the marketed version of the technology (including any algorithms used to calculate scores)
- Included a suitable reference standard
- Patient/sample clinical characteristics were described
- Patient/sample selection criteria were described.

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).

Clinically Useful
A test is clinically useful if the use of the results inform management decisions that improve the net health outcome of care. The net health outcome can be improved if patients receive correct therapy, more effective therapy, or avoid unnecessary therapy or 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. No RCTs were identified assessing the clinical utility of CCTA for suspected anomalous coronary arteries; however, case series exist.

Case Series
A number of case series have consistently reported that CCTA can delineate the course of these anomalous arteries, even when conventional angiography cannot.[54,55,56,57,]

Section Summary: Suspected Anomalous Coronary Arteries
Results from case series have shown that CCTA delineates the course of anomalous coronary arteries, even when conventional angiography cannot. However, none of the studies reported results when the initial reason for the study was to identify these anomalies, nor did any of the studies discuss the impact on therapeutic decisions. Given the uncommon occurrence of these symptomatic anomalies, it is unlikely that a prospective trial of CCTA could be completed.

Other Diagnostic Uses of Coronary Computed Tomography Angiography
Given its ability to define coronary artery anatomy, there are many potential diagnostic uses of CCTA, including patency of coronary artery bypass grafts, in-stent restenosis, screening, and preoperative evaluation.

Patency
Evaluating patency of vein grafts is less technically challenging due to vein size and lesser motion during imaging. In contrast, internal mammary grafts may be more difficult to image due to their small size and presence of surgical clips. Finally, assessing native vessels distal to grafts presents difficulties, especially when calcifications are present, due to their small size. In a systematic review, including results from 64-slice scanners, Stein et al (2008) reported high sensitivity (98%; 95% CI, 95% to 99%; 740 segments) and specificity (97%; 95% CI, 94% to 97%).[58,] Other small studies have reported high sensitivity and specificity.[59,60,] Lacking are multicenter studies demonstrating likely clinical benefit, particularly given the reasonably high disease prevalence in patients evaluated.

In-Stent Restenosis
Use of CCTA for evaluating in-stent restenosis presents other technical challenges: motion, beam-hardening, and partial volume averaging. Whether these challenges can be overcome to obtain sufficient accuracy and impact outcomes has not been demonstrated.

Screening
Use for screening a low-risk population was evaluated by McEvoy et al (2011) in patients undergoing CCTA (n=1000) or a control intervention (n=1000).[61] Findings reported in this study were abnormal in 215 screened patients. Over 18 months of follow-up, screening was associated with more invasive testing and statin use, but no difference in cardiac event rates.

Preoperative Evaluation
Use for screening in a high-risk population was evaluated in the Screening For Asymptomatic Obstructive Coronary Artery Disease Among High-Risk Diabetic Patients Using CT Angiography (FACTOR-64) trial, which randomized 900 subjects with diabetes to screening with CCTA or SOC.[62] Patients in this trial were asymptomatic, but considered to be at high-risk for CAD due to long-standing diabetes. The primary outcome was a composite of mortality, nonfatal MI, or unstable angina requiring hospitalization. At a median follow-up of 4 years, there was no significant difference between the groups for the primary outcome (CCTA, 6.2% vs control, 7.6%; HR=0.80; p=.38).

The utility of CCTA for the pre-operative screening of patients undergoing noncardiac surgery with an intermediate- to high-risk of CAD was assessed by Koshy et al (2019).[63] While current guidelines recommend stress testing in individuals at intermediate- to high-risk, over one-third of perioperative MACE occur among those with negative test results. Occurrence of MACE was reported in 7.2% of 3480 patients. Risk of perioperative MACE was found to increase with the severity of CAD on CCTA findings (no CAD, 2.0%; non-obstructive CAD, 4.1%; obstructive single-vessel, 7.1%; obstructive multivessel, 23.1%; p <.001). Obstructive multivessel CAD predicted the highest risk of MACE (odds ratio 8.9, 95% CI, 5.1 to 15.3; p <.001). In a high-risk subgroup, absence of multivessel disease demonstrated a high negative predictive value of 96% (95% CI, 92.8 to 98.4). The investigators acknowledge that the prognostic value of these findings has unclear clinical utility, as it is not known how non-obstructive or single-vessel CAD findings would change the clinical management of patients. Additionally, prior studies have not demonstrated a benefit of preoperative medical therapy or revascularization in lowering the incidence of MACE.

Summary of Evidence
For individuals who have acute chest pain and suspected coronary artery disease in the emergency setting, at intermediate- to low-risk, who receive CCTA, the evidence includes several RCTs , a systematic review, and a prospective head-to-head study comparing CCTA with an alternative noninvasive test. Relevant outcomes are overall survival, morbid events, and resource utilization. Trials have shown similar patient outcomes, with faster patient discharges from the emergency department, and lower short-term costs. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have stable chest pain, intermediate-risk of coronary artery disease, and meeting guideline criteria for noninvasive testing (i.e., intermediate-risk) who receive CCTA, the evidence includes studies of diagnostic accuracy of CCTA, randomized trials and observational studies comparing CCTA with alternative diagnostic strategies, and systematic reviews. Relevant outcomes are overall survival, test accuracy, morbid events, and resource utilization. Studies of diagnostic accuracy have shown that CCTA has higher sensitivity and similar specificity to alternative noninvasive tests. Although randomized trials have not shown the superiority of CCTA over other diagnostic strategies, results are consistent with noninferiority (i.e., similar health outcomes) to other diagnostic strategies. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have suspected anomalous coronary arteries who receive CCTA, the evidence includes case series. Relevant outcomes are overall survival, test accuracy, morbid events, and resource utilization. Series have shown that CCTA can detect anomalous coronary arteries missed by other diagnostic modalities. Anomalous coronary arteries are rare, and formal studies to assess clinical utility are unlikely to be performed. In most situations, these case series alone would be insufficient to determine whether the test improves health outcomes. However, in situations where patient management will be affected by CCTA results (e.g., with changes in surgical planning), a chain of evidence indicates that health outcomes are improved. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

Supplemental Information
The purpose of the following information is to provide reference material. Inclusion does not imply endorsement or alignment with the evidence review conclusions.

Practice Guidelines and Position Statements
Guidelines or position statements will be considered for inclusion in 'Supplemental Information' if they were issued by, or jointly by, a US professional society, an international society with US representation, or National Institute for Health and Care Excellence (NICE). Priority will be given to guidelines that are informed by a systematic review, include strength of evidence ratings, and include a description of management of conflict of interest.

American College of Cardiology Foundation et al
The American College of Cardiology Foundation and several other medical societies (2012) issued joint guidelines for the management of patients with stable ischemic heart disease (Table 21).[38]

Table 21. Guidelines on Management of Stable IHD

Diagnosis	Recommendation	Class	LOE
Unknown			
	Able to exercise		
	"CCTA might be reasonable for patients with an intermediate pretest probability of IHD who have at least moderate physical functioning or no disabling comorbidity."	IIb	B
	Unable to exercise		
	"CCTA is reasonable for patients with a low-to-intermediate pretest probability of IHD who are incapable of at least moderate physical functioning or have a disabling comorbidity."	IIa	B
	"CCTA is reasonable for patients with an intermediate pretest probability of IHD who a) have continued symptoms with prior normal test findings, or b) have inconclusive results from prior exercise or pharmacological stress testing, or c) are unable to undergo stress with nuclear MPI or echocardiography."	IIa	C
Known coronary disease			
	Able to exercise		
	"CCTA may be reasonable for risk assessment in patients with SIHD who are able to exercise to an adequate workload but have an uninterpretable ECG."	IIb	B
	Able to exercise		
	"Pharmacological stress imaging (nuclear MPI, echocardiography, or CMR) or CCTA is not recommended for risk assessment in patients with SIHD who are able to exercise to an adequate workload and have an interpretable ECG."	III	C
	Unable to exercise		
	"Pharmacological stress CMR is reasonable for risk assessment in patients with SIHD who are unable to exercise to an adequate workload regardless of interpretability of ECG."	IIa	B

Diagnosis	Recommendation	Class	LOE
	"CCTA can be useful as a first-line test for risk assessment in patients with SIHD who are unable to exercise to an adequate workload regardless of interpretability of ECG."	IIa	C
	Unable to exercise		
	"A request to perform either a) more than 1 stress imaging study or b) a stress imaging study and a CCTA at the same time is not recommended for risk assessment in patients with SIHD."	III	C
	Regardless of patients' ability to exercise		
	"CCTA might be considered for risk assessment in patients with SIHD unable to undergo stress imaging or as an alternative to invasive coronary angiography when functional testing indicates a moderate- to high-risk result and knowledge of angiographic coronary anatomy is unknown."	IIb	C

CCTA: coronary computed tomography angiography; CMR: cardiac magnetic resonance; ECG: electrocardiography; IHD: ischemic heart disease; LOE: level of evidence; MPI: myocardial perfusion imaging; SIHD: stable ischemic heart disease.

The American College of Cardiology Foundation and other medical societies (2013) published appropriate use criteria for detection and risk assessment of stable ischemic heart disease.[64] Coronary computed tomography angiography (CCTA) was considered appropriate for:

- Symptomatic patients with intermediate (10% to 90%) pretest probability of coronary artery disease and uninterpretable electrocardiogram (ECG) or inability to exercise
- Patients with newly diagnosed systolic heart failure
- Patients who have had a prior exercise ECG or stress imaging study with abnormal or unknown results
- Patients with new or worsening symptoms and normal exercise ECG.

National Institute for Health and Care Excellence

The National Institute for Health and Care Excellence (2016) has recommended CCTA as first-line testing for patients with stable angina if the clinical assessment indicates typical or atypical angina, or if the clinical assessment indicates non anginal chest pain but 12-lead resting ECG has been done and indicates ST-T changes or Q waves.[65]

Society of Cardiovascular Computed Tomography

The Society of Cardiovascular Computed Tomography (2021) published an expert consensus document on CCTA.[66] Recommendations on use of CCTA in select patients are included in Table 22. In addition to the recommendations listed below, the expert consensus included additional recommendations in several patient populations, including patients with known coronary artery disease.

Table 22. Society of Cardiovascular Computed Tomography Guidelines on Coronary Computed Tomography Angiography

Diagnosis	Recommendation
Stable chest pain with no known CAD	It is appropriate to perform CTA as the first line test for evaluating patients with no known CAD who present with stable typical or atypical chest pain, or other symptoms which are thought to represent a possible anginal equivalent (eg, dyspnea on exertion, jaw pain).
	It is appropriate to perform coronary CTA following a nonconclusive functional test, in order to obtain more precision regarding diagnosis and prognosis, if such information will influence subsequent patient management.
	Coronary CTA is rarely appropriate in very low risk symptomatic patients, such as those <40 years of

Diagnosis	Recommendation
	age who have noncardiac symptoms (eg, chest wall pain, pleuritic chest pain).
Noncardiac surgery	It is appropriate to perform CTA as an alternative to other noninvasive tests for evaluation of selected patients prior to noncardiac surgery.
Coronary anomalies	It is appropriate to perform CTA for the evaluation of coronary anomalies.

CAD: coronary artery disease; CTA: cardiac computed tomography angiography.

U.S. Preventive Services Task Force Recommendations

No U.S. Preventive Services Task Force recommendations for CCTA have been identified.

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 ongoing trials that might influence this review are listed in Table 23.

Table 23. Summary of Key Trials

NCT Number	Title	Enrollment	Completion Date
Ongoing			
NCT02400229	Diagnostic Imaging Strategies for Patients With Stable Chest Pain and Intermediate Risk of Coronary Artery Disease: Comparative Effectiveness Research of Existing Technologies - A Pragmatic Randomised Controlled Trial of CT Versus ICA	3546	Mar 2022
NCT02284191	The Role of Early CT Coronary Angiography in the Evaluation, Intervention and Outcome of Patients Presenting to the Emergency Department With Suspected or Confirmed Acute Coronary Syndrome	1749	Dec 2020
NCT03129659	Coronary CT Angiography for Improved Assessment of Suspected Acute Coronary Syndrome With Inconclusive Diagnostic Work-up	230	Sep 2022
NCT02099019	Usefulness of Coronary Computed Tomography Angiography for Therapeutic Decision-Making; Revascularization	3000	Feb 2025

NCT: national clinical trial.

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Documentation for Clinical Review

Please provide the following documentation:

- History and physical and/or consultation notes including:
  - Current symptoms and clinical findings
  - Reason for the procedure
- Diagnostic radiology reports pertaining to request (e.g., echocardiogram, transesophageal echocardiogram, MRI)

Post Service (in addition to the above, please include the following):

- Radiology procedure report(s)

Coding

This Policy relates only to the services or supplies described herein. Benefits may vary according to product design; therefore, contract language should be reviewed before applying the terms of the Policy.

The following codes are included below for informational purposes. Inclusion or exclusion of a code(s) does not constitute or imply member coverage or provider reimbursement policy. Policy Statements are intended to provide member coverage information and may include the use of some codes for clarity. The Policy Guidelines section may also provide additional information for how to interpret the Policy Statements and to provide coding guidance in some cases.

Type	Code	Description
CPT®	0623T	Automated quantification and characterization of coronary atherosclerotic plaque to assess severity of coronary disease, using data from coronary computed tomographic angiography; data preparation and transmission, computerized analysis of data, with review of computerized analysis output to reconcile discordant data, interpretation and report
	0624T	Automated quantification and characterization of coronary atherosclerotic plaque to assess severity of coronary disease, using data from coronary computed tomographic angiography; data preparation and transmission
	0625T	Automated quantification and characterization of coronary atherosclerotic plaque to assess severity of coronary disease, using data from coronary computed tomographic angiography; computerized analysis of data from coronary computed tomographic angiography
	0626T	Automated quantification and characterization of coronary atherosclerotic plaque to assess severity of coronary disease, using data from coronary computed tomographic angiography; review of computerized analysis output to reconcile discordant data, interpretation and report
	75572	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)
	75573	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 left ventricular [LV] cardiac function, right ventricular [RV] structure and function and evaluation of vascular structures, if performed) ***(Code revision effective 1/1/2022)***
	75574	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)
HCPCS	None	

Policy History

This section provides a chronological history of the activities, updates and changes that have occurred with this Medical Policy.

Effective Date	Action
04/03/2009	Policy Name Change Combined: • Electron Beam Computed Tomography (EBCT) for Detection and Evaluation of Coronary Artery Calcium Measurement • Contrast-Enhanced Computed Tomography Angiography (CTA)for Coronary Artery Evaluation
01/15/2010	Coding Update
01/06/2012	Policy title change from Cardiac Computed Tomography with position change
07/31/2015	Coding update
02/01/2017	Policy title change from Cardiac Computed Tomography (CT) and Coronary CT Angiography Policy revision without position change BCBSA Medical Policy adoption
11/01/2017	Policy revision without position change
11/01/2018	Policy revision without position change
12/01/2019	Policy revision without position change
12/01/2020	Annual review. Policy statement, guidelines and literature updated.
01/01/2021	Coding Update.
11/01/2021	Annual review. No change to policy statement. Literature review updated.
02/01/2022	Coding Update.

Definitions of Decision Determinations

Medically Necessary: Services that are Medically Necessary include only those which have been established as safe and effective, are furnished under generally accepted professional standards to treat illness, injury or medical condition, and which, as determined by Blue Shield, are: (a) consistent with Blue Shield medical policy; (b) consistent with the symptoms or diagnosis; (c) not furnished primarily for the convenience of the patient, the attending Physician or other provider; (d) furnished at the most appropriate level which can be provided safely and effectively to the patient; and (e) not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of the Member's illness, injury, or disease.

Investigational/Experimental: A treatment, procedure, or drug is investigational when it has not been recognized as safe and effective for use in treating the particular condition in accordance with generally accepted professional medical standards. This includes services where approval by the federal or state governmental is required prior to use, but has not yet been granted.

Split Evaluation: Blue Shield of California/Blue Shield of California Life & Health Insurance Company (Blue Shield) policy review can result in a split evaluation, where a treatment, procedure, or drug will be considered to be investigational for certain indications or conditions, but will be deemed safe and effective for other indications or conditions, and therefore potentially medically necessary in those instances.

Prior Authorization Requirements (as applicable to your plan)

Within five days before the actual date of service, the provider must confirm with Blue Shield that the member's health plan coverage is still in effect. Blue Shield reserves the right to revoke an

authorization prior to services being rendered based on cancellation of the member's eligibility. Final determination of benefits will be made after review of the claim for limitations or exclusions.

Questions regarding the applicability of this policy should be directed to the Prior Authorization Department at (800) 541-6652, or the Transplant Case Management Department at (800) 637-2066 ext. 3507708 or visit the provider portal at www.blueshieldca.com/provider.

Disclaimer: This medical policy is a guide in evaluating the medical necessity of a particular service or treatment. Blue Shield of California may consider published peer-reviewed scientific literature, national guidelines, and local standards of practice in developing its medical policy. Federal and state law, as well as contract language, including definitions and specific contract provisions/exclusions, take precedence over medical policy and must be considered first in determining covered services. Member contracts may differ in their benefits. Blue Shield reserves the right to review and update policies as appropriate.

Appendix A

POLICY STATEMENT (No changes)	
BEFORE	**AFTER**
Contrast-Enhanced Computed Tomographic Angiography for Coronary Artery Evaluation 6.01.43 **Policy Statement:** Contrast-enhanced coronary computed tomography angiography (CCTA) may be considered **medically necessary** for evaluation of patients with acute chest pain and without known coronary artery disease in the emergency department setting. Contrast-enhanced coronary computed tomography angiography (CCTA) may be considered **medically necessary** for evaluation of patients with stable chest pain and meeting guideline criteria for a noninvasive test in the outpatient setting (see Policy Guidelines). Contrast-enhanced coronary computed tomography angiography (CCTA) may be considered **medically necessary** for evaluation of patients with suspected anomalous (native) coronary arteries. Contrast-enhanced coronary computed tomography angiography (CCTA) for coronary artery evaluation is considered **investigational** for all other indications.	**Contrast-Enhanced Computed Tomographic Angiography for Coronary Artery Evaluation 6.01.43** **Policy Statement:** Contrast-enhanced coronary computed tomography angiography (CCTA) may be considered **medically necessary** for evaluation of patients with acute chest pain and without known coronary artery disease in the emergency department setting. Contrast-enhanced coronary computed tomography angiography (CCTA) may be considered **medically necessary** for evaluation of patients with stable chest pain and meeting guideline criteria for a noninvasive test in the outpatient setting (see Policy Guidelines). Contrast-enhanced coronary computed tomography angiography (CCTA) may be considered **medically necessary** for evaluation of patients with suspected anomalous (native) coronary arteries. Contrast-enhanced coronary computed tomography angiography (CCTA) for coronary artery evaluation is considered **investigational** for all other indications.