

Year	Author	Title	Journal	Grade (oxford* therapy/prevention/etiology/harm)	(Notes)	Rule	Rule (simple)
2016	van Waardhuizen	Comparative cost-effectiveness of non-invasive imaging tests in patients presenting with chronic stable chest pain with suspected coronary artery disease: a systematic review	European Heart Journal – Quality of Care and Clinical Outcomes	1a-	heterogenous systematic review, 70 studies included	Suggests economically optimal diagnostic imaging strategy for patients suspected of having CAD is CTCA for low disease probability, stress echo or SPECT MPI for intermediate disease probability, and invasive CAG for high disease probability. This study does not provide definitive conclusions.	The most cost-effective imaging modality is dependant on the pre-test probability of CAD
2016	Bittencourt	Clinical Outcomes After Evaluation of Stable Chest Pain by Coronary Computed Tomographic Angiography Versus Usual Care: A Meta-Analysis	Circulation: Cardiovascular Imaging	1a	Meta-analysis of 4 RCTs with 14,817 patients	For patients with stable chest pain and suspected CAD, use of CCTA was associated with decreased rate of MI and higher revascularization procedure with no difference in all cause mortality or cardiac admissions compared to "usual" care.	Initial CCTA in patients with suspected CAD decreased rate of MI, increased revascularization with no change in all-cause mortality compared to usual care
2007	Sabharwal	A randomized trial of exercise treadmill ECG versus stress SPECT myocardial perfusion imaging as an initial diagnostic strategy in stable patients with chest pain and suspected CAD: Cost analysis	Journal of Nuclear Cardiology	1b	RCT of 457 patients	For patients with stable chest pain, there is no difference in cost to CAD diagnosis between EST and MPI. However, in patients with low pre-test probability, EST was less costly.	No difference in cost between ETT and MPI for diagnosis of CAD in patients with stable chest pain.
2012	Min	Coronary CT angiography versus myocardial perfusion imaging for near-term quality of life, cost and radiation exposure: A prospective multicenter randomized pilot trial	Journal of Cardiovascular Computed Tomography	1b	RCT of 180 patients	For patients with stable chest pain and suspected CAD, CCTA is associated with more aggressive medical therapy, increased coronary revascularization, lower total costs, and lower effective radiation dose compared to MPI. There was no difference in short-term angina specific health status (SAQ)	CCTA appears more effective than MPI
2014	Thom	Cost-effectiveness of initial stress cardiovascular MR, stress SPECT or stress echocardiography as a gate-keeper test, compared with upfront invasive coronary angiography in the investigation and management of patients with stable chest pain: mid-term outcomes from the CECaT randomised controlled trial	BMJ Open	1b	898 randomized 1:1:1:1	In patients with stable angina and a positive exercise tolerance test, use of any one of stress CMR, stress ECHO or stress SPECT as the initial test for a stable chest pain patient leads to non-inferior outcomes in quality of life and cost-utility compared with patients randomised to upfront invasive CA.	stress CMR, stress ECHO or stress SPECT are safe and not excessively expensive to use as gatekeeper for PCI in patients with stable chest pain
2015	McKavanagh	A comparison of cardiac computerized tomography and exercise stress electrocardiogram test for the investigation of stable chest pain: the clinical results of the CAPP randomized prospective trial	European Heart Journal – Cardiovascular Imaging	1b	RCT of 500 patients	For patients with stable chest pain and suspected CAD, CCTA was associated with higher angina stability and QOL domains (SAQ), more significant disease identified, more revascularizations compared to EST. Patients undergoing EST had longer mean time to management, more inconclusive tests, and more emergency/cardiac attendances/admissions. No difference in major cardiac events	"Cardiac CT as an index investigation for stable chest pain improved angina symptoms and resulted in fewer investigations and re-hospitalizations compared with EST" with no difference in major cardiac events.
2015	Douglas	Outcomes of Anatomical versus Functional Testing for Coronary Artery Disease	NEJM	1b	RCT of 10,003 patients as part of PROMISE Trial	For patients with stable chest pain and suspected CAD, there was no difference in death, MI, disease specific hospitalization, or procedural complication between CCTA and functional testing. CCTA had more CAs overall but fewer normal CAs. Overall radiation dose higher in CCTA group.	"Initial CTA, as compared with functional testing, did not improve clinical outcome at 2 years"
2015	The SCOT-HEART investigators	CT coronary angiography in patients with suspected angina due to coronary heart disease (SCOT-HEART): an open-label, parallel-group, multicentre trial	The Lancet	1b	RCT of 9849 patients randomized to standard care+CCTA vs. standard care alone	For patients with stable chest pain and suspected CAD, use of CCTA changed management strategy and treatment plan without affecting 6-week symptom severity of hospital re-admission. CCTA may reduce risk of fatal and non-fatal MI	CCTA clarifies diagnosis and alters management while possibly reducing risk of MI
2016	Williams- SCOT-HEART Investigators.	Use of Coronary Computed Tomographic Angiography to Guide Management of Patients With Coronary Disease	JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY	1b	Prospective, randomized, multicenter RCT with 4,146 patients	In patients with stable suspected angina due to coronary heart disease, CCTA leads to more appropriate use of invasive angiography (fewer normal vessels and more obstructing lesions in those patients who had pre-angio CCTA), more preventive therapies, and 50% decrease in fatal and non-fatal myocardial infarction.	CCTA improves clinical outcomes in patients with stable angina "CCTA is as an effective and readily applicable gatekeeper for the conduct of invasive coronary angiography"
2016	Lubbers	Calcium imaging and selective computed tomography angiography in comparison to functional testing for suspected coronary artery disease: the multicentre, randomized CRESCENT trial	European Heart Journal	1b	RCT of 350 Patients	For patients with stable chest pain and suspected CAD, tiered CAC followed by CCTA resulted in fewer anginal complaints, higher event-free survival, earlier diagnosis of CAD, fewer subsequent tests, and decreased cost. Tiered imaging is associated with slightly higher radiation dose.	Tiered cardiac imaging is safe, more effective, and less costly than functional testing.

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2016	Agus	The cost-effectiveness of cardiac computedtomography for patients with stable chest pain	Heart	1b	RCT of 500 patients randomized to CCTA or EST	For patients with stable chest pain and suspected CAD, CCTA is less costly and more effective and associated with QALY gain. CCTA is most cost effective at lower pre-test probabilities of CAD	CCTA is less costly and increases QALY compared to EST
2016	Greenwood	Effect of Care Guided by Cardiovascular Magnetic Resonance, Myocardial Perfusion Scintigraphy, or NICE Guidelines on Subsequent Unnecessary Angiography Rates: The CE-MARC 2 Randomized Clinical Trial.	JAMA	1b	RCT of 1202 patients randomized to 3 parallel groups (MR, MPI, or NICE guidelines)	For patients with stable chest pain and suspected CAD, MR resulted in fewer unnecessary CAs with no difference between MR and MPI. No difference in positive CAs, MACE or procedural complications	MR decreases unnecessary CAs compared to NICE
2017	Lu	Safety of coronary CT angiography and functional testing for stablechest pain in the PROMISE trial: A randomized comparison of testcomplications, incidentalfindings, and radiation dose	Journal of Cardiovascular Computed Tomography	1b	RCT of 9470 patients as part of PROMISE Trial	CCTA and functional testing strategies have negligible complications with similar radiation dose. CCTA picked up more incidental findings. and lower radiation dose than MPI. Lowest CCTA dose @ high volume centers (>500 CTAs/yr)	CCTA and functional tests are equally safe with lower radiation dose in CCTA compared to MPI
2017	Hoffman	Prognostic Value of Noninvasive Cardiovascular Testing in Patients with Stable Chest Pain: Insights from the PROMISE Trial	Circulation	1b	RCT of 9102 patients as part of PROMISE Trial	For patients with stable chest pain and suspected CAD, CCTA is associated with fewer normal test results, fewer cardiovascular events, and better prognostic ability compared to functional testing by improved identification of at-risk patients with non-obstructive CAD.	CCTA is more able to detect non-obstructive CAD compared to functional testing which results in better prognostic information
2018	Rudziński	The value of Coronary Artery computed Tomography as thefirst-lineanatomical test for stable patients with indications for invasive angiographydue to suspected Coronary Artery Disease: CAT-CAD randomized trial	Journal of Cardiovascular Computed Tomography	1b	RCT of 120 patients	For patients with stable chest pain and suspected CAD, CCTA as first-line test reduced the number of ICA and decreased the number of ICAs not followed by coronary intervention.	CCTA is an effective "gatekeeper" to PCI by decreasing number of unnecessary examinations
2018	Corcoran	Coronary microvascular dysfunction in patients with stable coronaryartery disease: The CE-MARC 2 coronary physiology sub-study	International Journal of Cardiology	1b	RCT of 1202 patients randomized to MPI or management based on the pre-test probability of CAD (10–29%: CAC+CCTA; 30–60%: MPS; 61–90%: invasive coronary angiography)	For patients with stable chest pain and high pre-test probability of CAD who undergo CA, microvascular dysfunction is common.	
2019	Wolny	Computed tomography angiography versus angiography for guidingpercutaneous coronary interventions in bifurcation lesions -A prospective randomized pilot study	Journal of Cardiovascular Computed Tomography	1b	RCT with 45 lesions in CTA+angio group and 47 lesions in angio group alone	Use of CTA in addition to angiography to guide PCI in patients with stable coronary bifurcation lesions resulted in more frequent single-stent procedures with proximal optimization, less frequent two-stent overlap, and decreased side-branch stenting with the same immediate angiographic result (lumen diameters and fractional flow reserve) and complication rate compared to angiography alone.	Use of CTA does not change technical success but has potentially beneficial changes to PCI technique
2013	Gueret	Diagnostic Performance of Computed Tomography CoronaryAngiography (from the Prospective National Multicenter MultivendorEVASCAN Study)	The American Journal of Cardiology	2b	746 patients underwent CCTA followed by CA	For intermediate- to high-risk patients with stable chest pain and suspected CAD, CCTA had 91 % sensitivity, 83% NPV, 1.82 negative likelihood ratio, 50% specificity, 68% PPV, and 0.18 positive likelihood ratio. Low specificity and PPV likely due to overestimation of stenosis. Strongest predictors of false negative was high pre-test probability.	CCTA has high sensitivity and NPV for identifying CAD although high pre-test probability increases rate of false negatives.
2015	Youness	Very high coronary artery calcium score with normal myocardialperfusion SPECT imaging is associated with a moderate incidence of severe coronary artery disease	European Journal of Nuclear Medicine and Molecular Imaging	2b	Prospective cohort study of 2,659 consecutive patients	Normal SPECT MPI and very high calcium score in stable patients without known CAD is associated with moderate incidence of severe CAD requiring either PCI or CABG. Patients with normal MPI but very high CAC and typical chest pain were more likely to have severe CAD than those patients with atypical chest pain	Normal MPI but very high CAC = intermediate probability of severe CAD. Addition of typical chest pain = more likely to have severe CAD
2015	Arbab-Zadeh	Accuracy of Computed Tomographic Angiography and Single-Photon Emission Computed Tomography–Acquired Myocardial Perfusion Imaging for the Diagnosis of Coronary Artery Disease	Circulation: Cardiovascular Imaging	2b	391 patients underwent MPI and CCTA followed by CA for gold-standard diagnosis	For patients with stable chest pain and suspected CAD, CCTA was more sensitive and accurate than MPI for identifying patient with CAD with lower radiation dose. In patients with CAC>400 or high-risk anatomy had similar accuracy due to lower CCTA specificity	CCTA is more sensitive and accurate than MPI in diagnosing CAD for stable symptomatic patients with suspected CAD

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2016	Douglas	1-Year Outcomes of FFR _{CT} -Guided Care in Patients With Suspected Coronary Disease	Journal of the American College of Cardiology	2b	584 patients managed by "usual tesing (invasive and non-invasive) vs. CTA with FFR	For patients with stable chest pain and intermediate probability of CAD, CTA with FFR had equivalent clinical outomes and lower overall cost compated to "usual" care at 1 year.	CTA with FFR is non-inferior and less expensive than "usual" care
2017	Buckert	Left ventricular ejection fraction and presence of myocardialnecrosis assessed by cardiac magnetic resonance imaging correctlyrisk stratify patients with stable coronary artery disease:a multi-center all-comers trial	Clinical Research in Cardiology	2b	2422 patients referred for cardiac viability testing	For patients with stable chest pain and known or suspected CAD, assessment of left ventricular ejection fraction and late gadolinium enhancement can risk stratify patients into low, mid, and high risk for cardiac death or non-fatal MI	LVEF and LGE can be used to risk straitfy patients with known or suspected CAD

Glossary of Terms and Notes

ACS	acute coronary syndromes						
CCTA	coronary computed tomographic angiography						
CA	Coronary Angiography						
ICA	invasive coronary angiography			NOTE: Functional Testing = EST, stress ECHO, nuclear stress test (MPI)			
RCT	randomized control trial						
SOC	standard of care						

Stable Chest Pain Evidence Table - Grouped Results

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Benefits of CTA								
2016	Williams- SCOT-HEART	Use of Coronary Computed Tomographic Angiography to Guide Management of Patients With Coronary Disease	Journal of American College of Cardiology	1b	Prospective, randomized, multicenter RCT with 4,146 patients	In patients with stable suspected angina due to coronary heart disease, CCTA leads to more appropriate use of invasive angiography (fewer normal vessels and more obstructing lesions in those patients who had pre-angio CCTA), more preventive therapies, and 50% decrease in fatal and non-fatal myocardial infarction.	CCTA improves clinical outcomes in patients with stable angina "CCTA is as an effective and readily applicable gatekeeper for the conduct of invasive coronary angiography"	UK
2019	Wolny	Computed tomography angiography versus angiography for guiding percutaneous coronary interventions in bifurcation lesions -A prospective randomized pilot study	Journal of Cardiovascular Computed Tomography	1b	RCT with 45 lesions in CTA+angio group and 47 lesions in angio group alone	Use of CTA in addition to angiography to guide PCI in patients with stable coronary bifurcation lesions resulted in more frequent single-stent procedures with proximal optimization, less frequent two-stent overlap, and decreased side-branch stenting with the same immediate angiographic result (lumen diameters and fractional flow reserve) and complication rate compared to angiography alone.	Use of CTA does not change technical success but has potentially beneficial changes to PCI technique	Poland
2018	Rudziński	The value of Coronary Artery computed Tomography as the first-line anatomical test for stable patients with indications for invasive angiography due to suspected Coronary Artery Disease: CAT-CAD randomized trial	Journal of Cardiovascular Computed Tomography	1b	RCT of 120 patients	For patients with stable chest pain and suspected CAD, CCTA as first-line test reduced the number of ICA and decreased the number of ICAs not followed by coronary intervention.	CCTA is an effective "gatekeeper" to PCI by decreasing number of unnecessary examinations	Needs long-term f/u Poland
2012	Min	Coronary CT angiography versus myocardial perfusion imaging for near-term quality of life, cost and radiation exposure: A prospective multicenter randomized pilot trial	Journal of Cardiovascular Computed Tomography	1b	RCT of 180 patients	For patients with stable chest pain and suspected CAD, CCTA is associated with more aggressive medical therapy, increased coronary revascularization, lower total costs, and lower effective radiation dose compared to MPI. There was no difference in short-term angina specific health status (SAQ)	CCTA appears more effective than MPI	Needs long-term f/u
2015	McKavanagh	A comparison of cardiac computerized tomography and exercise stress electrocardiogram test for the investigation of stable chest pain: the clinical results of the CAPP randomized prospective trial	European Heart Journal – Cardiovascular Imaging	1b	RCT of 500 patients	For patients with stable chest pain and suspected CAD, CCTA was associated with higher angina stability and QOL domains (SAQ), more significant disease identified, more revascularizations compared to EST. Patients undergoing EST had longer mean time to management, more inconclusive tests, and more emergency/cardiac attendances/admissions. No difference in major cardiac events	"Cardiac CT as an index investigation for stable chest pain improved angina symptoms and resulted in fewer investigations and re-hospitalizations compared with EST" with no difference in major cardiac events.	UK study
Cost Effectiveness								
2016	van Waardhuizen	Comparative cost-effectiveness of non-invasive imaging tests in patients presenting with chronic stable chest pain with suspected coronary artery disease: a systematic review	European Heart Journal – Quality of Care and Clinical Outcomes	?	heterogeneous systematic review, 70 studies included	Suggests economically optimal diagnostic imaging strategy for patients suspected of having CAD is CTCA for low disease probability, stress echo or SPECT MPI for intermediate disease probability, and invasive CAG for high disease probability. This study does not provide definitive conclusions.	The most cost-effective imaging modality is dependent on the pre-test probability of CAD	Not sure what Oxford grade to give this because it is a heterogeneous systematic review. No imaging was under-represented. There is such variation and insignificant conclusions such that I am not sure these results even mean anything Netherlands
2007	Sabharwal	A randomized trial of exercise treadmill ECG versus stress SPECT myocardial perfusion imaging as an initial diagnostic strategy in stable patients with chest pain and suspected CAD: Cost analysis	Journal of Nuclear Cardiology	1b	RCT of 457 patients	For patients with stable chest pain, there is no difference in cost to CAD diagnosis between EST and MPI. However, in patients with low pre-test probability, EST was less costly.	No difference in cost between ETT and MPI for diagnosis of CAD in patients with stable chest pain.	UK study Older study
2012	Min	SEE ABOVE SECTION						
Benefits of CAC								
2015	Youness	Very high coronary artery calcium score with normal myocardial perfusion SPECT imaging is associated with a moderate incidence of severe coronary artery disease	European Journal of Nuclear Medicine and Molecular Imaging	2b	Prospective cohort study of 2,659 consecutive patients	Normal SPECT MPI and very high calcium score in stable patients without known CAD is associated with moderate incidence of severe CAD requiring either PCI or CABG. Patients with normal MPI but very high CAC and typical chest pain were more likely to have severe CAD than those patients with atypical chest pain	Normal MPI but very high CAC = intermediate probability of severe CAD. Addition of typical chest pain = more likely to have severe CAD	Normal MPI does not rule out severe CAD High incidence of severe CAD in patients with typical chest pain, normal MPI, and very high CAC UK
Functional Testing								

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2014	Thom	Cost-effectiveness of initial stress cardiovascular MR, stress SPECT or stress echocardiography as a gate-keeper test, compared with upfront invasive coronary angiography in the investigation and management of patients with stable chest pain: mid-term outcomes from the CECaT randomized controlled trial	BMJ Open	1b	898 randomized 1:1:1:1	In patients with stable angina and a positive exercise tolerance test, use of any one of stress CMR, stress ECHO or stress SPECT as the initial test for a stable chest pain patient leads to non-inferior out-comes in quality of life and cost-utility compared with patients randomized to upfront invasive CA.	stress CMR, stress ECHO or stress SPECT are safe and not excessively expensive to use as gatekeeper for PCI in patients with stable chest pain	Canada