Appendix D - Clinical Evidence Extractions

Question 1: What are the education and information needs in adults presenting with chest pain to optimise their understanding of the diagnostic process and their participation in decisions about their investigations?

Grading: 1+ Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias

Arnold J;Goodacre S;Bath P;Price J;

Information sheets for patients with acute chest pain: randomised controlled trial

Ref ID 25415 Brit Med J pgs: b541 to b546 2009

Study Type Randomised Controlled Trial **Funding** Health Foundation Leadership Practice Award

Number of participant	Intervention group, n=349; Control group n=351. Total n=700.
Inclusion/Exclusion Criteria	Subjects were patients who were investigated for chest pain of possible cardiac origin, were aged over 25, had no changes for acute coronary syndrome on a diagnostic electrocardiogram, had no suspected life threatening non-cardiac disease and did not have known coronary heart disease presenting with recurrent or prolonged episodes of cardiac type chest pain. Patients were excluded if they were unable to read or comprehend the trial documentation.
Patient Characteristics	The study population had a mean age of 48.6 years, and 61.6% were men. Information sheets were deemed suitable for 19 patients with a diagnosis of angina (mean age 69,58% men) 162 with a diagnosis of definite benign non-cardiac pain (mean age 43, 65% men), 61 with a diagnosis of uncertain cause requiring further cardiology investigation (mean age 52, 49% men), and 458 with a diagnosis of uncertain cause suitable for expectant management (mean age 49, 62% men).
Recruitment	The aim was to recruit 700 consecutive patients who had been investigated for suspected acute coronary syndrome. The chest pain nurses identified eligible patients.
Setting	Chest pain unit, emergency centre, Sheffield
Interventions/ Test/ Factor being investigated	The objective was to determine whether providing an information sheet to patients with acute hest pain reduces anxiety, improves health related quality of life, improves satisfaction with care or alters subsequent symptoms or actions. Four separate information sheets were developed: definite angina, definite benign non-cardiac chest pain, uncertain cause requiring further cardiology investigation and uncertain cause suitable for expectant management.
Comparisons	This study compared those receiving standard verbal advice with those receiving advice and an information sheet.
Length of Study/ Follow-up	One month after recruitment all patients were sent a questionnaire by post. Questionnaires were resent to non-responders at six and eight weeks.
Outcome measures studied	The primary outcome was scores on the anxiety subscale of the hospital anxiety and depression scale. Secondary outcomes included the depression and SF-36 scores;satisfaction;further symptoms; life style changes
Results	494 of 700 (70.6%) responses. Compared with those receiving standard verbal advice those receiving advice and an information sheet had significantly lower anxiety scores 7.61 versus 8.63 (95% CI 0.20 to 1.84, p=0.015) and depression scores 4.14 versus 5.28 (95% CI 0.41 to 1.86, p=0.002). On the anxiety subscale, intervention was associated with a shift from mild or moderate anxiety to no anxiety; on the depression subscale the intervention was associated with a shift towards lower scores among those with no depression and also a reduction in the proportion with moderate depression. The number needed to treat to avoid one case of anxiety was 9.0 and the NNT for depression was 13.1. Patients in the intervention group had significantly higher scores for mental health (p<0.007) and general health perception (p<0.006) on the SF-36 than those in the control group. There were no other significant differences between the two groups.
Safety and adverse effects	None reported

Does the study answer the question?	Provision of an information sheet to patients with acute chest pain can reduce anxiety and depression and improve mental health and perception of general health but does not alter satisfaction with care or other outcomes. The authors of the study conclude that as the information sheets are simple to administer and outcomes were on balance positive, the use of these sheets should be recommended in patients receiving diagnostic assessment for acute chest pain.
Effect due to factor in study?	There are some limitations which may bias the outcome of this study: it is not blinded; there was a 30% non response rate to the questionnaire; there was potential for contamination between groups by the nurses giving the information on the information sheet verbally to the control group.
Consistency of results with other studies?	There are no other studies in this field.
Directly applicable to guideline population?	This study population excluded all patients who could not read English. Thus it may not be generalisable to all individuals with chest pain.
Internal Validity	Subjects are not blinded; 29% non response

Question 2: What is the incremental benefit and cost effectiveness of a clinical history, risk factors and physical examination in evaluation of individuals with acute chest pain of suspected cardiac origin?

Grading: 1++ High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias

Bruyninckx R;Aertgeerts B;Bruyninckx P;Buntinx F;

Signs and symptoms in diagnosing acute myocardial infarction and acute coronary syndrome: a diagnostic meta-analysis

Ref ID 10251 Br J Gen Pract pgs: e1 to e8 2008

Study Type Meta-analysis **Funding** Not reported

Number of participant	28 prospective and retrospective observational studies
Inclusion/Exclusion Criteria	Studies had to describe at least 1 of the 10 signs and symptoms for diagnosing ACS or AMI, and based on original data
Patient Characteristics	Patients with signs and symptoms for the diagnosis of acute MI, unstable angina or ACS.
Recruitment	
Setting	Secondary and primary care
Interventions/ Test/ Factor being investigated	The signs and symptoms considered were pain in left arm and/or shoulder, pain in right arm and/or shoulder, pain in both arms, pain in neck, pain in back, epigastric pain, oppressive pain, vomiting and/or nausea, sweating or absence of chest wall tenderness
Comparisons	Signs and symptoms to diagnose chest pain
Length of Study/ Follow-up	
Outcome measures studied	
Results	The results of the meta-analysis showed that absence of chest wall tenderness was highly sensitive for AMI and ACS (92 % and 94% respectively). It was seen that when the patient presented with pain on palpation the chance of an AMI or ACS was greatly reduced (LR- 0.23 and 0.17 respectively). The analysis showed that oppressive pain had a sensitivity of 60% and specificity of 58% and had almost no influence on the likelihood of the patient having an AMI. The other signs and symptoms considered in the study had lower sensitivity and specificity and therefore could not be used to exclude an AMI or ACS. See narrative for question 1; Table 2: Bruyninckx et al, 2004 See narrative for question 1; Table 3: Bruyninckx et al, 2004 The sensitivity of absence of tenderness was high, namely 92% (95% CI = 85.5 to 96.4) for acute myocardial infarction and 94% (95% CI = 91.4 to 96.1) for acute coronary syndrome. Oppressive pain followed with a sensitivity of 60% (95% CI = 53.7 to 66.0 for acute myocardial infarction). Sweating had the highest LR+, namely 2.92 (95% CI = 1.97 to 4.32 for acute myocardial infarction). The LR+ of right arm or shoulder pain was 2.89 (95% CI = 1.40 to 5.98) for acute myocardial infarction (one study). The other LR+ fluctuated between 1.05 and 1.49 for acute coronary syndrome. Absence of tenderness had a LR- of 0.23 (95% CI = 0.18 to 0.29) for acute myocardial infarction and 0.17 (95% CI = 0.11 to 0.26) for acute coronary syndrome. Other LR– varied between 0.69 (oppressive pain and sweating for acute myocardial infarction) and 0.98 (epigastric pain) for acute coronary syndrome.
Safety and adverse effects	None reported

Does the study answer the question?

5606 papers were initially identified of these 28 papers met the inclusion criteria for the use of 10 signs and symptoms, the studies included were prospective and retrospective observational studies, more than half of the studies were published since Mant et al's selection for the HTA published in 2004. A total of 46,908 patients were included in the review. The signs and symptoms considered were pain in left arm and/or shoulder, pain in right arm and/or shoulder, pain in both arms, pain in neck, pain in back, epigastric pain, oppressive pain, vomiting and/or nausea, sweating or absence of chest wall tenderness. Of the 28 papers, 11 were set in the emergency department, 10 were set in coronary care unit or the patients had been admitted to hospital, 3 were on the paramedics in an ambulance, 2 were set in GPs, 1 was carried out by a cardiologist and 1 was in a chest pain observational unit. 16 of the studies had non-selected patients, 11 had selected patients and 1 was from a chest pain observation unit. Selected patients were those who were recruited by coronary care units and cardiologists. All studies included patients had chest pain, in two studies patients also had pulmonary oedema. The mean age of the participants in all the studies was 53-71 years old, and the % of males was from 40-71%.

The results of the meta-analysis showed that absence of chest wall tenderness was highly sensitive for AMI and ACS (92 % and 94% respectively). It was seen that when the patient presented with pain on palpation the chance of an AMI or ACS was greatly reduced (LR- 0.23 and 0.17 respectively). The analysis showed that oppressive pain had a sensitivity of 60% and specificity of 58% and had almost no influence on the likelihood of the patient having an AMI. The other signs and symptoms considered in the study had lower sensitivity and specificity and therefore could not be used to exclude an AMI or ACS.

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The authors concluded that it was not possible to define an important role for signs and symptoms in the diagnosis of AMI or ACS. Only chest wall tenderness on palpation largely ruled out AMI or ACS.

See tables for detailed results
(NB pleuritic pain not considered)

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

Correct population

Internal Validity

Mant J;McManus RJ;Oakes RL;Delaney BC;Barton PM;Deeks JJ;Hammersley L;Davies RC;Davies MK;Hobbs FR;

Systematic review and modelling of the investigation of acute and chronic chest pain presenting in primary care

Ref ID 728 Health technology assessment pgs: 1 to 158 2004

Study Type Systematic Review

Funding NHS R&D Health Technology Assessment Programme

Number of participant	21 observational studies
Inclusion/Exclusion Criteria	Papers used at least one of the signs and symptoms in the diagnosis of chest pain
Patient Characteristics	
Recruitment	
Setting	8 secondary care, 10 A&E, 3 primary secondary care
Interventions/ Test/ Factor being investigated	The signs and symptoms considered were pluritic pain, sharp pain, positional pain, pain on palpation, crushing pain, central pain, left-sided radiation pain, right-sided radiation pain, any radiation of pain, pain duration of longer than 1 hour, previous MI/angina, nausea/vomiting, sweating, pulmonary crackles, systolic blood pressure under 80 mmHg or a third heart sound
Comparisons	Signs and symptoms to diagnose chest pain
Length of Study/ Follow-up	
Outcome measures studied	
Results	None of the signs and symptoms in isolation were found to be particularly useful: no sign or symptom achieved an LR of <0.1 or >10.22 Indeed, only one of the upper limits of the 95% CIs exceeded 10 – for right-sided radiation of pain in diagnosis of ACS – which was based on only one study. Similarly, only one of the lower limits (for pain on palpation) was <0.1. The results for presence of a sign or symptom (LR+) were more informative than those for the absence of a symptom or sign (LR–) which were non-contributory to making a diagnosis in every case. Systolic hypotension, the presence of a third heart sound and right-sided radiation of chest pain, achieved the highest positive LRs (LR+ 3.21–2.59) for diagnosis of MI. Where the reference standard was MI or unstable angina, right-sided radiation was associated with a higher positive LR (6.68). Clinical features most helpful in ruling out the diagnosis were the presence of pleuritic, sharp or positional pain, and pain produced by palpation (LR+ 0.19–0.32). It should be noted that there was considerable heterogeneity in the results, particularly (although not exclusively) for the negative LRs. This makes the summary statistics difficult to interpret. Nevertheless, there is no evidence that any single symptom or sign taken in isolation is of much value in the diagnosis of acute chest pain. See narrative for question 1; Table 4: Mant et al, 2004
Safety and adverse effects	None reported
Does the study answer the question?	10862 papers were initially identified of these 21 papers met the inclusion criteria for the use of 16 difference clinical signs and symptoms. A total of 38638 patients were included in the review. The signs and symptoms considered were pleuritic pain, sharp pain, positional pain, pain on palpation, crushing pain, central pain, left-sided radiation pain, right-sided radiation pain, any radiation of pain, pain duration of longer than 1 hour, previous MI/angina, nausea/vomiting, sweating, pulmonary crackles, systolic blood pressure under 80 mmHg or a third heart sound. Of the 21 papers, 8 were set in secondary care, 10 in A&E, and 3 in primary and secondary care. The mean age of the participants in all the studies was 50-73 years old, and the % of males was from 50-71%. None of these in isolation were found to be particularly useful: no sign or symptom achieved an LR of <0.1 or >10.22 Indeed, only one of the upper limits of the 95% CIs exceeded 10 – for right-sided radiation of pain in diagnosis of ACS – which was based on only one study. Similarly, only one of the lower limits (for pain on palpation) was <0.1. The results for presence of a sign or symptom (LR+) were more informative than those for the absence of a symptom or sign (LR–) which were non-contributory to making a diagnosis in every case. Systolic hypotension, the presence of a third heart sound and right-sided radiation of chest pain, achieved the highest positive LRs (LR+ 3.21–2.59) for diagnosis of MI. Where the reference standard was MI or unstable angina, right-sided radiation was associated with a higher positive LR (6.68). Clinical features most helpful in ruling out the diagnosis were the presence of

pleuritic, sharp or positional pain, and pain produced by palpation (LR+ 0.19–0.32). It should be noted that there was considerable heterogeneity in the results, particularly (although not exclusively) for the negative LRs. This makes the summary statistics difficult to interpret. Nevertheless, there is no evidence that any single symptom or sign taken in isolation is of much value in the diagnosis of acute chest pain.

See tables for detailed results;
See narrative for question 1; Table 4: Mant et al, 2004

Effect due to factor in study? Yes

Consistency of results with other studies? Consistent

Directly applicable to guideline population? Correct population

Internal Validity

Mant J;McManus RJ;Oakes RL;Delaney BC;Barton PM;Deeks JJ;Hammersley L;Davies RC;Davies MK;Hobbs FR;

Systematic review and modelling of the investigation of acute and chronic chest pain presenting in primary care

Ref ID 728 Health technology assessment pgs: 1 to 158 2004

Study Type Systematic Review

Funding NHS R&D Health Technology Assessment Programme

Number of participant 21 observational studies

Inclusion/Exclusion Criteria papers used at least one of the signs and symptoms in the diagnosis of chest pain

Patient Characteristics

Recruitment

Setting 8 secondary care, 10 A&E, 3 primary&secondary care

Interventions/ Test/ Factor being investigated The signs and symptoms considered were pluritic pain, sharp pain, positional pain, pain on palpation, crushing pain, central pain, left-sided radiation pain, right-sided radiation pain, any radiation of pain, pain duration of longer than 1 hour, previous MI/angina, nausea/vomiting, sweating, pulmonary crackles, systolic blood pressure under 80 mmHg or a third heart sound

Comparisons Signs and symptoms to diagnose chest pain

Length of Study/ Follow-up

Outcome measures studied

Results None of the signs and symptoms in isolation were found to be particularly useful: no sign or symptom achieved an LR of <0.1 or >10.22 Indeed, only one of the upper limits of the 95% CIs exceeded 10 – for right-sided radiation of pain in diagnosis of ACS – which was based on only one study. Similarly, only one of the lower limits (for pain on palpation) was <0.1. The results for presence of a sign or symptom (LR+) were more informative than those for the absence of a symptom or sign (LR–) which were non-contributory to making a diagnosis in every case. Systolic hypotension, the presence of a third heart sound and right-sided radiation of chest pain, achieved the highest positive LRs (LR+ 3.21–2.59) for diagnosis of MI. Where the reference standard was MI or unstable angina, right-sided radiation was associated with a higher positive LR (6.68). Clinical features most helpful in ruling out the diagnosis

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See narrative for question 22; Table 1: Mant et al, 2004

Safety and adverse effects

None reported

Does the study answer the question?

10862 papers were initially identified of these 21 papers met the inclusion criteria for the use of 16 difference clinical signs and symptoms. A total of 38638 patients were included in the review. The signs and symptoms considered were pluritic pain, sharp pain, positional pain, pain on palpation, crushing pain, central pain, left-sided radiation pain, right-sided radiation pain, any radiation of pain, pain duration of longer than 1 hour, previous MI/angina, nausea/vomiting, sweating, pulmonary crackles, systolic blood pressure under 80 mmHg or a third heart sound. Of the 21 papers, 8 were set in secondary care, 10 in A&E, and 3 in primary and secondary care. The mean age of the participants in all the studies was 50-73 years old, and the % of males was from 50-71%.

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See tables for detailed results
See narrative for question 22; Table 1: Mant et al, 2004

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

Correct population

Internal Validity

Swap CJ;Nagurney JT;

Value and limitations of chest pain history in the evaluation of patients with suspected acute coronary syndromes

Ref ID 381 JAMA : the journal of the American Medical Association pgs: 2623 to 2629 2005

Study Type Systematic Review **Funding** Not reported

Number of participant

28 prospective and retrospective observational studies and systematic reviews

Inclusion/Exclusion Criteria

Studies needed to be observational studies including at least 80 patients. Studies needed to include at least 1 chest pain characteristic and make a diagnosis of ACS or AMI with appropriate diagnostic tests

Patient Characteristics	Patients described at least on chest pain characteristic which was diagnosed as ACS or AMI.
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	The studies considered the following chest pain characteristics: quality, location, radiation, size of area or distribution, severity, time of onset and is it continuing, duration, first occurrence frequency, similar to previous cardiac ischemic episodes and the following precipitating or aggravating factors: pleuritic, positional, palpable, exercise, emotional stress, relieving factors, associated symptoms
Comparisons	Chest pain characteristics for diagnosing chest pain
Length of Study/ Follow-up	
Outcome measures studied	
Results	Certain chest pain characteristics decrease the likelihood of ACS or AMI, namely, pain that is stabbing, pleuritic, positional, or reproducible by palpation (likelihood ratios [LRs] 0.2 to 0.3). Conversely, chest pain that radiates to one shoulder or both shoulders or arms or is precipitated by exertion is associated with LRs (2.3 to 4.7) that increase the likelihood of ACS. The chest pain history itself has not proven to be a powerful enough predictive tool to obviate the need for at least some diagnostic testing. Combinations of elements of the chest pain history with other initially available information, such as a history of CAD, have identified certain groups that may be safe for discharge without further evaluation, but further study is needed before such a recommendation can be considered reasonable. See narrative for question 1; Table 1: Swap and Nagurney, 2005.
Safety and adverse effects	None reported
Does the study answer the question?	28 papers were initially identified that were relevant to the evaluation of chest pain using signs and symptoms, the studies included were prospective and retrospective observational studies and systematic reviews, considering both predictors of AMI and ACS. The studies considered the following chest pain characteristics: quality, location, radiation, size of area or distribution, severity, time of onset and is it continuing, duration, first occurrence frequency, similar to previous cardiac ischemic episodes and the following precipitating or aggravating factors: pleuritic, positional, palpable, exercise, emotional stress, relieving factors, associated symptoms. Risk stratification for ACS according to components of chest pain history: Low risk: pain that is pleuritic, positional, or reproducible with palpation or is described as stabbing Probable low risk: pain not related to exertion or that occurs in a small inframammary area of the chest wall Probable high risk: pain described as pressure, is similar to that of prior MI or worse than prior anginal pain or is accompanied by nausea, vomiting or diaphoresis High risk: pain that radiates to one or both shoulders or arms or is relate to exertion See narrative for question 1; Table1: Swap and Nagurney, 2005 Certain chest pain characteristics decrease the likelihood of ACS or AMI, namely, pain that is stabbing, pleuritic, positional, or reproducible by palpation (likelihood ratios [LRs] 0.2 to 0.3). Conversely, chest pain that radiates to one shoulder or both shoulders or arms or is precipitated by exertion is associated with LRs (2.3 to 4.7) that increase the likelihood of ACS. The chest pain history itself has not proven to be a powerful enough predictive tool to obviate the need for at least some diagnostic testing. Combinations of elements of the chest pain history with other initially available information, such as a history of CAD, have identified certain groups that may be safe for discharge without further evaluation, but further study is needed before such a recommendation can be considered reasonable The authors concluded that although certain elements of the chest pain history are associated with increased (LR = 2.3 to 4.7) or decreased (LR = 0.2 to 0.3) likelihoods of a diagnosis of ACS or AMI, none of them alone or in combination identify a group of patients that can be safely discharged without further diagnostic testing

	See table for detailed results
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Conti A;Paladini B;Toccafondi S;Magazzini S;Olivotto I;Galassi F;Pieroni C;Santoro G;Antoniucci D;Berni G;

Effectiveness of a multidisciplinary chest pain unit for the assessment of coronary syndromes and risk stratification in the Florence area

Ref ID 926 American heart journal pgs: 630 to 635 2002

Study Type Cohort

Funding Italian Ministry for Scientific and Technological Research

Number of participant	13 762 patients
Inclusion/Exclusion Criteria	Inclusion: over 18 years old, chest pain defined as pain in the thoracic region, independent of duration, radiation, or relation to exercise, occurring in the last 24 hours and lasting minutes to hours
Patient Characteristics	The mean age was 65±18 years and 43% were women Those who were categorised as being at high risk (21%) had a mean age of 63±10 years, 33% were female, 35% smoked, 25% had diabetes, 38% had hypertension, 13.4 % died during the follow up. Those who were categorised as being at intermediate risk (47%) had a mean age of 64±11 years, 38% were female, 33% smoked, 28% had diabetes, 41% had hypertension, 2.2 % died during the follow up. Those who were categorised as being at low risk (32%) had a mean age of 38±15 years, 66% were female, 12% smoked, 8% had diabetes, 22% had hypertension, 0.2 % died during the follow up.
Recruitment	Admitted to emergency department with chest pain as described above
Setting	ED. Careggi General Hospital, Florence, Italy
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score was based on: location of pain, radiation of pain, character of pain, history of angina
Length of Study/ Follow-up	6 months
Outcome measures studied	Effectiveness of chest pain score in diagnosing chest pain
Results	The chest pain score was based on the following elements each of which was given a value: location of pain: substernal or precordial = +3, left chest, neck, lower jaw or epigastrium = +1, apex = -1; radiation of pain: arm, shoulder, back, neck or lower jaw = +1; character of pain: crushing, pressing or heaviness = +2 sticking, pleuritic or pinprick = -1; associated symptoms: dyspnea, nausea or diaphoresis = +2; history of angina = +3. The mean age was 65±18 years. Patients were classified into 1 of 4 groups. 1) Patients at low risk with obvious noncardiac causes of chest pain, chest pain score <4, normal ECG, and normal serum markers of cardiac injury obtained at least 6 hours from symptoms, were sent home and followed up. (2672 patients) 2) Patients at low risk with chest pain score ≥ 4, normal ECG, normal serum cardiac markers, independent of age or coexisting coronary risk factors, were not admitted and underwent a second-line evaluation and short-term observation in the CPU area, including chest radiography, serial 12-lead ECG, serial troponins and cardiac enzymes, echocardiography and arterial blood gas analysis. When at least one of these tests or procedure results was found to be suggestive of AMI, unstable angina or CAD or left ventricular failure was detected these patients were considered for angiography with no additional testing. After an observation period up to 6 hours

patients without ongoing cardiovascular events underwent exercise tolerance test or SPECT or stress echocardiography. (1755 patients)
3) Patients at intermediate risk with clinical score ≥ 4 and abnormal ECG (ST-segment elevation <1mm or ST-segment depression <1mm at 60ms from J point) were admitted and managed in the CPU area.
4) Patients at high risk with ECG suggestive for AMI (defined as ST elevation ≥1 mm at 60ms from J point, ≥2 contiguous leads) were directly transferred to the coronary care unit and patients with suspected major cardiovascular disease, such as aortic arch dissection, pulmonary embolism, pneumothorax and acute pericarditis, were admitted and managed with arterial blood gas analysis, chest radiography, echocardiography, and thorax computed tomography if required by clinical assessment.

At six month follow up 0.2% of these patients were recognised as having nonfatal coronary artery disease, hence, the negative predictive value of a chest pain score of < 4 and normal ECG was > 99%

Of the patients with a chest pain score ≥ 4 and normal or non diagnostic electrocardiogram results (1755 patients, 40%), 20% of the low risk group with chest pain score < 4 (group 1) (885 patients) had documented coronary artery disease, 18% of which were by recurrent angina, delayed ECG changes, late rise in markers, the other 2% was by positive stress test.
There were 9335 intermediate and high risk patients, of which 2420 patients (26%) had an MI, 3764 patients (40%) had unstable angina, 129 (1.4%) had aortic dissection and 408 (4%) had pulmonary embolism, other major cardiovascular conditions were diagnosed, including aortic arch dissection, pulmonary embolism, pneumothorax, and acute pericarditis. 2256 patients had atypical chest pain diagnosed as multi-organ disease including chronic and stable ischemic heart disease, defined as known stable angina, previous myocardial infarction, or angiographically documented CAD

Safety and adverse effects

None reported

Does the study answer the question?

Of the patients with a chest pain score > 4 and normal electrocardiogram results, 20% (885 patients) had documented coronary artery disease. There were 9335 intermediate and high risk patients, of which 2420 patients (26%) had an MI, 3764 patients (40%) had unstable angina, 129 (1.4%) had aortic dissection and 408 (4%) had pulmonary embolism. Other multi-organ disease was found in 2256 patients.

The authors concluded that the chest pain score screening programme was effective and could significantly reduce admissions and optimise the care of those with an intermediate or high risk score. The authors also concluded that the screening programme could aid the diagnosis of alternative causes of chest pain in patients who do not have evidence of coronary artery disease

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

Correct population

Internal Validity

Well covered

Sanchis J;BodÝ V;Llßcer A;N·±ez J;Consuegra L;Bosch MJ;Bertomeu V;Ruiz V;Chorro FJ;

Risk stratification of patients with acute chest pain and normal troponin concentrations

Ref ID 459 Heart (British Cardiac Society) pgs: 1013 to 1018 2005

Study Type Cohort

Funding Not reported

Number of participant

609 patients

Inclusion/Exclusion Criteria	Inclusion: Patients with chest pain of suspected cardiac origin as determined by a cardiologist on call with a negative troponin I concentration (measured at baseline, at 6, 8 and 12 hours). Exclusion: ST elevation, Left Bundle Branch Block, and heart failure, killip > 1
Patient Characteristics	The mean age was 64±12 years, 33% were women, 20% were current smokers, 59% had hypertension, 53% had hypercholesterolemia, 25% had diabetes, 44% had a history of IHD, 13% had a family history of IHD, 7% had had coronary surgery, 12% had ST depression, 9% had T wave inversion
Recruitment	Patients admitted to the emergency department in a teaching hospital in Spain
Setting	ED, teaching hospital in Spain
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score was based on: location, radiation, character, severity, what influenced the pain, associated symptoms, history of exertional angina. A clinical history, ECG and for those in the low risk group an early (<24 hours) exercise test
Length of Study/ Follow-up	6 months
Outcome measures studied	Effectiveness of chest pain score in diagnosing chest pain
Results	Troponin I concentrations were taken at arrival, 6 hours (is patient arrived within 2 hours of onset of pain), 8 hours and 12 hours after pain onset. All patients had normal troponin concentrations at each measurement. Patients underwent a chest pain score assessment, an ECG, and for those in the low risk group an early (<24 hours) exercise test. The chest pain score was based on: location (substernal) = +3, (precordial) = +2, (neck, jaw or epigastrium) = +1, (apical) = -1; radiation (either arm) = +2, (shoulder, back, neck or jaw) = +1; character (crushing, pressing or squeezing) = +3, (heaviness or tightness) = +2, (sticking, stabbing, pinprick or catching) = -1; severity (severe) = +2, (moderate) = +1; influenced by (glyceryl trinitrate) = +1, (stature) = -1, (breathing) = -1; associated symptoms (dyspnoea) = +2, (nausea or vomiting) = +2, (diaphoresis) = +2; history of exertional angina = +3. A clinical history was also taken (age, smoking, hypertension, hypercholesterolemia, diabetes, family history of IHD, history of IHD, previous coronary surgery) During a 6 month follow up, 25 patients (4.1%) had an acute MI, 9 (1.5%) died of cardiac causes and 29 (4.8%) had a major event (AMI or cardiac death). Those who could had a negative exercise test had a very good prognosis compared to those who did not have a negative exercise test or those who could not exercise and do and exercise test. See narrative for question 2; Table 2: Sanchis et al, 2005, Heart See narrative for question 2; Table 3: Sanchis et al, 2005, Heart For predictors of AMI the univariate and multivariate analysis showed: chest pain score (per point univariate P = 0.003, multivariate P = 0.009, odds ratio (OR) 1.2, 95%CI 1.1 to 1.4), age (per year univariate P = 0.02, multivariate P = 0.04, OR 1.04, 95%CI 1.01 to 1.09), men (univariate P = 0.008, multivariate P = 0.02, OR 3.7, 95%CI 1.2 to 11.1), smoking (univariate P = 0.4, multivariate P = not applicable (N.A.), OR N.A., 95%CI N.A.), hypertension (univariate P = 0.3, multivariate P = N.A., OR N.A., 95%CI N.A.), hypercholesterolemia (univariate P = 0.7, multivariate P = N.A., OR N.A., 95%CI N.A.), diabetes (univariate P = 0.03, multivariate P = 0.02, OR 2.5, 95%CI 1.1 to 5.7), family history of IHD (univariate P = 0.3, multivariate P = N.A., OR N.A., 95%CI N.A.), history of IHD (univariate P = 0.02, multivariate P = not significant (N.S.), OR N.A., 95%CI N.A.), coronary surgery (univariate P = 0.09, multivariate P = N.S., OR N.A., 95%CI N.A.) For predictors of a major event (AMI or cardiac death) the univariate and multivariate analysis showed: chest pain score (per point univariate P = 0.002, multivariate P = 0.001, odds ratio (OR) 1.2, 95%CI 1.1 to 1.4), age (per year univariate P = 0.01, multivariate P = N.S., OR N.A., 95%CI N.A.), men (univariate P = 0.2, multivariate P = N.A., OR N.A., 95%CI N.A.), smoking (univariate P = 0.5, multivariate P = N.A., OR

N.A., 95%CI N.A.), hypertension (univariate P = 0.2, multivariate P = N.A., OR N.A., 95%CI N.A.), hypercholesterolemia (univariate P = 1, multivariate P = N.A., OR N.A., 95%CI N.A.), diabetes (univariate P = 0.03, multivariate P = 0.03, OR 2.3, 95%CI 1.1 to 4.7), family history of IHD (univariate P = 1, multivariate P = N.A., OR N.A., 95%CI N.A.), history of IHD (univariate P = 0.007, multivariate P = N.S., OR N.A., 95%CI N.A.), coronary surgery (univariate P = 0.01, multivariate P = 0.01, OR 3.1, 95%CI 1.3 to 7.6)

The patients were stratifies according to the four independent risk factors associated with a major event (AMI or cardiac death), these were chest pain score, diabetes, previous coronary surgery and ST-segment depression. The event rate increased with the number of risk factors: no risk factors 2.5% event rate, 1 risk factor 2.9% event rate, 2 risk factors 10.2% event rate, 3 or 4 risk factors 29.2% event rate. Three risk categories were defined: low risk: no or 1 risk factor 2.7% event rate, intermediate risk: 2 risk factors 10.2% event rate, high risk: 3 or 4 risk factors 29.2% event rate. The differences between the 3 categories were all significant: high and intermediate (P = 0.001), high and low (P = 0.0001), intermediate and low (P = 0.008).

Safety and adverse effects

None reported

Does the study answer the question?

During a 6 month follow up, 25 patients (4.1%) had an acute MI, 9 (1.5%) died of cardiac causes and 29 (4.8%) had a major event (AMI or cardiac death). Multivariate analysis found that the following were independent factors in predicting an acute MI; higher chest pain score (per point, odds ratio (OR) 1.2, 95%CI 1.1 to 1.4, P = 0.009), older age (per year, OR 1.04, 95% CI 1.01 to 1.09, P = 0.04), male sex (OR 3.7, 95% CI 1.2 to 11.1, P = 0.02), and diabetes (OR 2.5, 95% CI 1.1 to 5.7, P = 0.02). For prediction of major events (AMI or cardiac death), the following were independent predictors; higher chest pain score (OR 1.2, 95% CI 1.1 to 1.4, P = 0.01), diabetes (OR 2.3, 95% CI 1.1 to 4.7, P = 0.03), ST segment depression (OR 2.8, 95% CI 1.13 to 6.3, 95%, P = 0.003), and previous coronary surgery (OR 3.1, 95% CI 1.3 to 7.6, P = 0.01). Further analysis found that the event rate increased progressively with the progression of the number of independent risk factors, with the event rate increasing with the number of risk factors: no risk factors 2.5% event rate, 1 risk factor 2.9% event rate, 2 risk factors 10.2% event rate, 3 or 4 risk factors 29.2% event rate. From this 3 risk categories, low intermediate and high, were formed with the difference between each being significant.

NB there is overlap of patients included in this study and the study Sanchis et al 2005, JACC (New Risk Score for Patients with Acute Chest Pain, Non-ST-Segment Deviation, and Normal Troponin Concentrations).

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

Correct population

Internal Validity

Well covered

Sanchis J;BodÝ V;Llßcer A;N·±ez J;Consuegra L;Bosch MJ;Bertomeu V;Ruiz V;Chorro FJ;

Risk stratification of patients with acute chest pain and normal troponin concentrations

Ref ID 459 Heart (British Cardiac Society) pgs: 1013 to 1018 2005

Study Type Cohort **Funding** Not reported

Number of participant

609 patients

Inclusion/Exclusion Criteria

Inclusion: Patients with chest pain of suspected cardiac origin as determined by a cardiologist on call with a negative troponin I concentration (measured at baseline, at 6, 8 and 12 hours). Exclusion: ST elevation, Left Bundle Branch Block, and heart failure, killip > 1

Patient Characteristics	The mean age was 64±12 years, 33% were women, 20% were current smokers, 59% had hypertension, 53% had hypercholesterolemia, 25% had diabetes, 44% had a history of IHD, 13% had a family history of IHD, 7% had had coronary surgery, 12% had ST depression, 9% had T wave inversion
Recruitment	Patients admitted to the emergency department in a teaching hospital in Spain
Setting	ED, teaching hospital in Spain
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score was based on: location, radiation, character, severity, what influenced the pain, associated symptoms, history of exertional angina. A clinical history, ECG and for those in the low risk group an early (<24 hours) exercise test
Length of Study/ Follow-up	6 months
Outcome measures studied	Effectiveness of chest pain score in diagnosing chest pain
Results	Troponin I concentrations were taken at arrival, 6 hours (is patient arrived within 2 hours of onset of pain), 8 hours and 12 hours after pain onset. All patients had normal troponin concentrations at each measurement. Patients underwent a chest pain score assessment, an ECG, and for those in the low risk group an early (<24 hours) exercise test. The chest pain score was based on: location (substernal) = +3, (precordial) = +2, (neck, jaw or epigastrium) = +1, (apical) = -1; radiation (either arm) = +2, (shoulder, back, neck or jaw) = +1; character (crushing, pressing or squeezing) = +3, (heaviness or tightness) = +2, (sticking, stabbing, pinprick or catching) = -1; severity (severe) = +2, (moderate) = +1; influenced by (glyceryl trinitrate) = +1, (ststure) = -1, (breathing) = -1; associated symptoms (dyspnoea) = +2, (nausea or vomiting) = +2, (diaphoresis) = +2; history of exertional angina = +3. A clinical history was also taken (age, smoking, hypertension, hypercholesterolemia, diabetes, family history of IHD, history of IHD, previous coronary surgery) During a 6 month follow up, 25 patients (4.1%) had an acute MI, 9 (1.5%) died of cardiac causes and 29 (4.8%) had a major event (AMI or cardiac death). Those who could had a negative exercise test had a very good prognosis compared to those who did not have a negative exercise test or those who could not exercise and do and exercise test. See narrative for question 1; Table 6: Sanchis et al, 2005, Heart See narrative for question 1; Table 7: Sanchis et al, 2005, Heart For predictors of AMI the univariate and multivariate analysis showed: chest pain score (per point univariate P = 0.003, multivariate P = 0.009, odds ratio (OR) 1.2, 95%CI 1.1 to 1.4), age (per year univariate P = 0.02, multivariate P = 0.04, OR 1.04, 95%CI 1.01 to 1.09), men (univariate P = 0.008, multivariate P = 0.02, OR 3.7, 95%CI 1.2 to 11.1), smoking (univariate P = 0.4, multivariate P = not applicable (N.A.), OR N.A., 95%CI N.A.), hypertension (univariate P = 0.3, multivariate P = N.A., OR N.A., 95%CI N.A.), hypercholesterolemia (univariate P = 0.7, multivariate P = N.A., OR N.A., 95%CI N.A.), diabetes (univariate P = 0.03, multivariate P = 0.02, OR 2.5, 95%CI 1.1 to 5.7), family history of IHD (univariate P = 0.3, multivariate P = N.A., OR N.A., 95%CI N.A.), history of IHD (univariate P = 0.02, multivariate P = not significant (N.S.), OR N.A., 95%CI N.A.), coronary surgery (univariate P = 0.09, multivariate P = N.S., OR N.A., 95%CI N.A.) For predictors of a major event (AMI or cardiac death) the univariate and multivariate analysis showed: chest pain score (per point univariate P = 0.002, multivariate P = 0.001, odds ratio (OR) 1.2, 95%CI 1.1 to 1.4), age (per year univariate P = 0.01, multivariate P = N.S., OR N.A., 95%CI N.A.), men (univariate P = 0.2, multivariate P = N.A., OR N.A., 95%CI N.A.), smoking (univariate P = 0.5, multivariate P = N.A., OR N.A., 95%CI N.A.), hypertension (univariate P = 0.2, multivariate P = N.A., OR N.A., 95%CI N.A.), hypercholesterolemia (univariate P = 1, multivariate P = N.A., OR N.A., 95%CI N.A.), diabetes (univariate P = 0.03, multivariate P = 0.03, OR 2.3, 95%CI 1.1

to 4.7), family history of IHD (univariate P = 1, multivariate P = N.A., OR N.A., 95%CI N.A.), history of IHD (univariate P = 0.007, multivariate P = N.S., OR N.A., 95%CI N.A.), coronary surgery (univariate P = 0.01, multivariate P = 0.01, OR 3.1, 95%CI 1.3 to 7.6)

The patients were stratifies according to the four independent risk factors associated with a major event (AMI or cardiac death), these were chest pain score, diabetes, previous coronary surgery and ST-segment depression. The event rate increased with the number of risk factors: no risk factors 2.5% event rate, 1 risk factor 2.9% event rate, 2 risk factors 10.2% event rate, 3 or 4 risk factors 29.2% event rate. Three risk categories were defined: low risk: no or 1 risk factor 2.7% event rate, intermediate risk: 2 risk factors 10.2% event rate, high risk: 3 or 4 risk factors 29.2% event rate. The differences between the 3 categories were all significant: high and intermediate (P = 0.001), high and low (P = 0.0001), intermediate and low (P = 0.008).

Safety and adverse effects

None reported

Does the study answer the question?

During a 6 month follow up, 25 patients (4.1%) had an acute MI, 9 (1.5%) died of cardiac causes and 29 (4.8%) had a major event (AMI or cardiac death). Multivariate analysis found that the following were independent factors in predicting an acute MI; higher chest pain score (per point, odds ratio (OR) 1.2, 95%CI 1.1 to 1.4, P = 0.009), older age (per year, OR 1.04, 95% CI 1.01 to 1.09, P = 0.04), male sex (OR 3.7, 95% CI 1.2 to 11.1, P = 0.02), and diabetes (OR 2.5, 95% CI 1.1 to 5.7, P = 0.02). For prediction of major events (AMI or cardiac death), the following were independent predictors; higher chest pain score (OR 1.2, 95% CI 1.1 to 1.4, P = 0.01), diabetes (OR 2.3, 95% CI 1.1 to 4.7, P = 0.03), ST segment depression (OR 2.8, 95% CI 1.13 to 6.3, 95%, P = 0.003), and previous coronary surgery (OR 3.1, 95% CI 1.3 to 7.6, P = 0.01). Further analysis found that the event rate increased progressively with the progression of the number of independent risk factors, with the event rate increasing with the number of risk factors: no risk factors 2.5% event rate, 1 risk factor 2.9% event rate, 2 risk factors 10.2% event rate, 3 or 4 risk factors 29.2% event rate. From this 3 risk categories, low intermediate and high, were formed with the difference between each being significant.

NB there is overlap of patients included in this study and the study Sanchis et al 2005, JACC (New Risk Score for Patients with Acute Chest Pain, Non-ST-Segment Deviation, and Normal Troponin Concentrations).

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

Correct population

Internal Validity

Well covered

Sanchis J;BodÝ V;N·±ez J;Bertomeu G;G¾mez C;Bosch MJ;Consuegra L;Bosch X;Chorro FJ;LlÓcer A;

New risk score for patients with acute chest pain, non-ST-segment deviation, and normal troponin concentrations: a comparison with the TIMI risk score

Ref ID 447 Journal of the American College of Cardiology pgs: 443 to 449 2005

Study Type Cohort **Funding** RECAVA-FIS

Number of participant

646 patients

Inclusion/Exclusion Criteria

Inclusion criteria: acute chest pain of possible cardiac origin Exclusion: if the initial ECG showed ST-segment deviation (≥1mm elevation or depression) or if they had troponin I elevation

Patient Characteristics	The mean age was 64±12 years and 32% were women. 20% were smokers, 59% had hypertension, 53% had hypercholesterolemia, 26% had diabetes mellitus, 7% insulin dependant diabetes mellitus, 12% had a family history of IHD, 13% had at least 3 risk factors, 24% had prior coronary stenosis ≥ 50%, 43% had used aspirin in the previous 7 days, 25% had a prior MI, 9% had prior PTCA, 8% had prior CABG, 2% had a history of heart failure. On ECG 10% had T-wave inversion,9% had confounding ECG
Recruitment	Patients admitted with acute chest pain to the emergency department in a teaching hospital in Spain during a 34 month period between 15th January 2001 and 30th November 2003
Setting	ED in a teaching hospital in Spain
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score and other variables, described in results
Length of Study/ Follow-up	1 year
Outcome measures studied	The primary end point was all cause mortality or nonfatal myocardial infarction, the secondary end point was all cause mortality, nonfatal myocardial infarction or urgent revascularisation at 14 day follow up.
Results	Troponin I concentrations were taken at arrival, 6 hours (is patient arrived within 2 hours of onset of pain), 8 hours and 12 hours after pain onset. All patients had normal troponin concentrations at each measurement. Patients underwent a chest pain score assessment based on: location (substernal) = +3, location (precordial) = +2, location (neck, jaw or epigastrium) = +1, location (apical) = -1; radiation (either arm) = +2, radiation (shoulder, back, neck or jaw) = +1; character (crushing, pressing or squeezing) = +3, character (heaviness or tightness) = +2, character (sticking, stabbing, pinprick or catching) = -1; severity (severe) = +2, severity (moderate) = +1; influenced by glyceryl trinitrate = +1, influenced by stature = -1, influenced by breathing = -1; associated symptoms (dyspnoea) = +2, (nausea or vomiting) = +2, (diaphoresis) = +2; history of exertional angina = +3. A clinical history was also taken (age, smoking, hypertension, hypercholesterolemia, diabetes, family history of coronary artery disease, history of coronary artery disease, previous coronary surgery). The following other variables were also determined: gender age, smoking, arterial hypertension, diabetes mellitus, insulin-dependant diabetes mellitus (IDDM), hypercholesterolemia, at least 3 risk factors for coronary artery disease, ≥ 2 chest pain episodes in last 24 hours, Killip class>1 at presentation, evidence of prior coronary stenosis ≥ 50%, use of aspirin in the last 7 days, prior PCI, prior CABG, and a history of heart failure. An ECG was recorded in the emergency room. At 1 year follow up, the primary end point (all-cause mortality or non-fatal MI) occurred in forty three patients (6.3%). At a 14 day follow up, the secondary end point (all-cause mortality or nonfatal myocardial infarction or urgent revascularisation) occurred in 35 patients (5.4%). The mean chest pain score was 10.4±2.8, 53% had ≥2 chest pain episodes in the previous 24 hours. See narrative for question 1; Table 8: Sanchis et al, 2005, JACC The univariate analysis showed that for: pain score ≥ 10 points (P = 0.001), ≥2 chest pain episodes in previous 24 hours (P = 0.001), Killip >1 (P = 0.1), age ≥67 (P = 0.004), men (P = 0.4), current smokers (P = 0.2), hypertension (P = 0.4), hypercholesterolemia (P = 0.6), diabetes mellitus (P = 0.001), IDDM (P = 0.0001), family history of IHD (P = 0.6), at least 3 risk factors (P = 0.8), prior coronary stenosis ≥ 50% (P = 0.1), use of aspirin in previous 7 days (P = 0.02), prior MI (P = 0.1), prior PTCA (P = 0.05), prior CABG (P = 0.1), history of heart failure (P = 0.6). See narrative for question 1; Table 8: Sanchis et al, 2005, JACC The multivariate analysis showed that for: pain score ≥ 10 points (hazard ratio (HR) 2.5, 95%CI 1.2-5.6, P = 0.02), ≥2 chest pain episodes in previous 24 hours (HR 2.2, 95%CI 1.2-4.2, P = 0.01), age ≥67 (HR 2.3, 95%CI 1.2-4.4, P = 0.01), IDDM (HR 4.2, 95%CI 2.1-8.4, P = 0.0001), prior PTCA (HR 2.2, 95%CI 1.1-4.8, P = 0.04). The multivariate analysis gave P values for the following: Killip >1 (P = 0.7), diabetes mellitus (P = 0.2), prior coronary stenosis ≥ 50% (P = 0.7), use of aspirin in previous

7 days (P = 0.6), prior MI (P = 0.9), prior CABG (P = 0.8). The multivariate analysis did not give results for: men, current smokers, hypertension, hypercholesterolemia, family history of IHD, at least 3 risk factors, history of heart failure.

From the multivariate analysis it was shown that the following were independent factors in predicting all cause mortality or nonfatal myocardial infarction; a chest pain score ≥ 10 points (hazard ratio (HR) 2.5, 95%CI 1.2 to 5.6, P = 0.02), ≥ 2 chest pain episodes in last 24 hours (HR 2.2, 95% CI 1.2 to 4.2, P = 0.01), age ≥ 67 years (HR 2.3, 95% CI 1.2 to 4.4, P = 0.01), IDDM (HR 4.2, 95% CI 2.1 to 8.4, P = 0.0001), and prior PCI (HR 2.2, 95% CI 1.1 to 4.8, P = 0.04).

The study constructed a risk score from 5 variables which were shown to be independently related to the primary end point. The variables with similar HR (chest pain score ≥ 10, ≥ 2 chest pain episodes in the last 24 hours, age ≥ 67 years and prior PCI) were assigned a 1 point value. IDDM was assigned a 2 point value as the HR value was twice the HR value of the other variables. This risk score gave the following patient population distribution: 0 points: n=111 (17.2%), 1 point: n=198 (30.7%), 2 points: n=206 (31.9%), 3 points: n=103 (15.9%), 4 points: n=16 (2.5%), 5 points: n=11 (1.7%), 6 points: n=1 (0.2%). The study combined 4-6 points due to the low number of patients giving the distribution: 4-6 points: n=25 (4.3%). The study then distinguished the 5 points values as: very low-risk (0 points, primary end point = 0%), low-risk (1 points, primary end point = 3.1%), intermediate-risk (2 points, primary end point = 5.4%), high-risk (3 points, primary end point = 17.6%) and very high-risk (≥4 points, primary end point = 29.6%). These were statistically significant with a P = 0.00001. The differences between the groups were also significant (comparing very low-, low-, intermediate-risk to very high-risk P = 0.0001, P = 0.0001, P = 0.0001 respectively; comparing very low-, low-, intermediate-risk to high-risk P = 0.002, P = 0.0001, P = 0.0001 respectively).

The new risk score was then compared with calculated TIMI scores. The new risk score had an accuracy C index of 0.78 (P = 0.0001) compared with the TIMI score C index of 0.66 (P = 0.0001), and the accuracy of the new score was significantly greater compared with the TIMI score (P = 0.0002).

The accuracy of both the new risk score and the TIMI score were tested for the secondary end point (death, MI or urgent revascularization at 14 days, which the TIMI score was originally designed for). The new risk score had a C index of 0.70 (P = 0.0001) and the TIMI score and a C index of 0.66 (P = 0.002) were correlated to the secondary end point but there was no significant difference (P = 0.1).

Safety and adverse effects

None reported

Does the study answer the question?

Multivariate analysis found that the following were independent factors in predicting all cause mortality or nonfatal myocardial infarction; a chest pain score ≥ 10 points (hazard ratio (HR) 2.5, 95%CI 1.2 to 5.6, P = 0.02), ≥ 2 chest pain episodes in last 24 hours (HR 2.2, 95% CI 1.2 to 4.2, P = 0.01), age ≥ 67 years (HR 2.3, 95% CI 1.2 to 4.4, P = 0.01), IDDM (HR 4.2, 95% CI 2.1 to 8.4, P = 0.0001), and prior PCI (HR 2.2, 95% CI 1.1 to 4.8, P = 0.04).

The study constructed a risk score from 5 variables which were shown to be independently related to the primary end point. The variables with similar HR (chest pain score ≥ 10, ≥ 2 chest pain episodes in the last 24 hours, age ≥ 67 years and prior PCI) were assigned a 1 point value. IDDM was assigned a 2 point value as the HR value was twice the HR value of the other variables. This risk score gave the following patient population distribution: 0 points: n=111 (17.2%), 1 point: n=198 (30.7%), 2 points: n=206 (31.9%), 3 points: n=103 (15.9%), 4 points: n=16 (2.5%), 5 points: n=11 (1.7%), 6 points: n=1 (0.2%). The study combined 4-6 points due to the low number of patients giving the distribution: 4-6 points: n=25 (4.3%). The study then distinguished the 5 points values as: very low-risk (0 points, primary end point = 0%), low-risk (1 points, primary end point = 3.1%), intermediate-risk (2 points, primary end point = 5.4%), high-risk (3 points, primary end point = 17.6%) and very high-risk (≥4 points, primary end point = 29.6%). These were statistically significant with a P = 0.00001. The differences between the groups were also significant (comparing very low-, low-, intermediate-risk to very high-risk P = 0.0001, P = 0.0001, P = 0.0001 respectively; comparing very low-, low-, intermediate-risk to high-risk P = 0.002, P = 0.0001, P = 0.0001 respectively).

The new risk score was then compared with calculated TIMI scores. The new risk score had an accuracy C index of 0.78 (P = 0.0001) compared with the TIMI score C

	index of 0.66 (P = 0.0001), and the accuracy of the new score was significantly greater compared with the TIMI score (P = 0.0002). The accuracy of both the new risk score and the TIMI score were tested for the secondary end point (death, MI or urgent revascularization at 14 days, which the TIMI score was originally designed for). The new risk score had a C index of 0.70 (P = 0.0001) and the TIMI score and a C index of 0.66 (P = 0.002) were correlated to the secondary end point but there was no significant difference (P = 0.1). NB there is overlap of patients included in this study and the study Sanchis et al 2005, Heart J (Risk Stratification of Patients with Acute Chest Pain and Normal Troponin Concentrations).
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Sanchis J;BodÝ V;N·±ez J;Bertomeu G;G¾mez C;Bosch MJ;Consuegra L;Bosch X;Chorro FJ;LlÓcer A;

New risk score for patients with acute chest pain, non-ST-segment deviation, and normal troponin concentrations: a comparison with the TIMI risk score

Ref ID 447 Journal of the American College of Cardiology pgs: 443 to 449 2005

Study Type	Cohort	**Funding**	RECAVA-FIS

Number of participant	646 patients
Inclusion/Exclusion Criteria	Inclusion criteria: acute chest pain of possible cardiac origin Exclusion: if the initial ECG showed ST-segment deviation (≥1mm elevation or depression) or if they had troponin I elevation
Patient Characteristics	The mean age was 64±12 years and 32% were women. 20% were smokers, 59% had hypertension, 53% had hypercholesterolemia, 26% had diabetes mellitus, 7% insulin dependant diabetes mellitus, 12% had a family history of IHD, 13% had at least 3 risk factors, 24% had prior coronary stenosis ≥ 50%, 43% had used aspirin in the previous 7 days, 25% had a prior MI, 9% had prior PTCA, 8% had prior CABG, 2% had a history of heart failure. On ECG 10% had T-wave inversion,9% had confounding ECG
Recruitment	Patients admitted with acute chest pain to the emergency department in a teaching hospital in Spain during a 34 month period between 15th January 2001 and 30th November 2003
Setting	ED in a teaching hospital in Spain
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score and other variables, described in results
Length of Study/ Follow-up	1 year
Outcome measures studied	The primary end point was all cause mortality or nonfatal myocardial infarction, the secondary end point was all cause mortality, nonfatal myocardial infarction or urgent revascularisation at 14 day follow up.

Results

Troponin I concentrations were taken at arrival, 6 hours (is patient arrived within 2 hours of onset of pain), 8 hours and 12 hours after pain onset. All patients had normal troponin concentrations at each measurement.

Patients underwent a chest pain score assessment based on: location (substernal) = +3, location (precordial) = +2, location (neck, jaw or epigastrium) = +1, location (apical) = -1; radiation (either arm) = +2, radiation (shoulder, back, neck or jaw) = +1; character (crushing, pressing or squeezing) = +3, character (heaviness or tightness) = +2, character (sticking, stabbing, pinprick or catching) = -1; severity (severe) = +2, severity (moderate) = +1; influenced by glyceryl trinitrate = +1, influenced by stature = -1, influenced by breathing = -1; associated symptoms (dyspnoea) = +2, (nausea or vomiting) = +2, (diaphoresis) = +2; history of exertional angina = +3. A clinical history was also taken (age, smoking, hypertension, hypercholesterolemia, diabetes, family history of coronary artery disease, history of coronary artery disease, previous coronary surgery). The following other variables were also determined: gender age, smoking, arterial hypertension, diabetes mellitus, insulin-dependant diabetes mellitus (IDDM), hypercholesterolemia, at least 3 risk factors for coronary artery disease, ≥ 2 chest pain episodes in last 24 hours, Killip class>1 at presentation, evidence of prior coronary stenosis ≥ 50%, use of aspirin in the last 7 days, prior PCI, prior CABG, and a history of heart failure. An ECG was recorded in the emergency room.

At 1 year follow up, the primary end point (all-cause mortality or non-fatal MI) occurred in forty three patients (6.3%). At a 14 day follow up, the secondary end point (all-cause mortality or nonfatal myocardial infarction or urgent revascularisation) occurred in 35 patients (5.4%). The mean chest pain score was 10.4±2.8, 53% had ≥2 chest pain episodes in the previous 24 hours.

See narrative for question 2; Table 4: Sanchis et al, 2005, JACC
The univariate analysis showed that for: pain score ≥ 10 points (P = 0.001), ≥2 chest pain episodes in previous 24 hours (P = 0.001), Killip >1 (P = 0.1), age ≥67 (P = 0.004), men (P = 0.4), current smokers (P = 0.2), hypertension (P = 0.4), hypercholesterolemia (P = 0.6), diabetes mellitus (P = 0.001), IDDM (P = 0.0001), family history of IHD (P = 0.6), at least 3 risk factors (P = 0.8), prior coronary stenosis ≥ 50% (P = 0.1), use of aspirin in previous 7 days (P = 0.02), prior MI (P = 0.1), prior PTCA (P = 0.05), prior CABG (P = 0.1), history of heart failure (P = 0.6).

See narrative for question 2; Table 4: Sanchis et al, 2005, JACC
The multivariate analysis showed that for: pain score ≥ 10 points (hazard ratio (HR) 2.5, 95%CI 1.2-5.6, P = 0.02), ≥2 chest pain episodes in previous 24 hours (HR 2.2, 95%CI 1.2-4.2, P = 0.01), age ≥67 (HR 2.3, 95%CI 1.2-4.4, P = 0.01), IDDM (HR 4.2, 95%CI 2.1-8.4, P = 0.0001), prior PTCA (HR 2.2, 95%CI 1.1-4.8, P = 0.04). The multivariate analysis gave P values for the following: Killip >1 (P = 0.7), diabetes mellitus (P = 0.2), prior coronary stenosis ≥ 50% (P = 0.7), use of aspirin in previous 7 days (P = 0.6), prior MI (P = 0.9), prior CABG (P = 0.8). The multivariate analysis did not give results for: men, current smokers, hypertension, hypercholesterolemia, family history of IHD, at least 3 risk factors, history of heart failure.

From the multivariate analysis it was shown that the following were independent factors in predicting all cause mortality or nonfatal myocardial infarction; a chest pain score ≥ 10 points (hazard ratio (HR) 2.5, 95%CI 1.2 to 5.6, P = 0.02), ≥ 2 chest pain episodes in last 24 hours (HR 2.2, 95% CI 1.2 to 4.2, P = 0.01), age ≥ 67 years (HR 2.3, 95% CI 1.2 to 4.4, P = 0.01), IDDM (HR 4.2, 95% CI 2.1 to 8.4, P = 0.0001), and prior PCI (HR 2.2, 95% CI 1.1 to 4.8, P = 0.04).

The study constructed a risk score from 5 variables which were shown to be independently related to the primary end point. The variables with similar HR (chest pain score ≥ 10, ≥ 2 chest pain episodes in the last 24 hours, age ≥ 67 years and prior PCI) were assigned a 1 point value. IDDM was assigned a 2 point value as the HR value was twice the HR value of the other variables. This risk score gave the following patient population distribution: 0 points: n=111 (17.2%), 1 point: n=198 (30.7%), 2 points: n=206 (31.9%), 3 points: n=103 (15.9%), 4 points: n=16 (2.5%), 5 points: n=11 (1.7%), 6 points: n=1 (0.2%). The study combined 4-6 points due to the low number of patients giving the distribution: 4-6 points: n=25 (4.3%). The study then distinguished the 5 points values as: very low-risk (0 points, primary end point = 0%), low-risk (1 points, primary end point = 3.1%), intermediate-risk (2 points, primary end point = 5.4%), high-risk (3 points, primary end point = 17.6%) and very high-risk (≥4 points, primary end point = 29.6%). These were statistically significant with a P = 0.00001. The differences between the groups were also significant (comparing very low-, low-, intermediate-risk to very high-risk P = 0.0001, P = 0.0001, P = 0.0001

respectively; comparing very low-, low-, intermediate-risk to high-risk P = 0.002, P = 0.0001, P = 0.0001 respectively).

The new risk score was then compared with calculated TIMI scores. The new risk score had an accuracy C index of 0.78 (P = 0.0001) compared with the TIMI score C index of 0.66 (P = 0.0001), and the accuracy of the new score was significantly greater compared with the TIMI score (P = 0.0002).

The accuracy of both the new risk score and the TIMI score were tested for the secondary end point (death, MI or urgent revascularization at 14 days, which the TIMI score was originally designed for). The new risk score had a C index of 0.70 (P = 0.0001) and the TIMI score and a C index of 0.66 (P = 0.002) were correlated to the secondary end point but there was no significant difference (P = 0.1).

Safety and adverse effects

None reported

Does the study answer the question?

Multivariate analysis found that the following were independent factors in predicting all cause mortality or nonfatal myocardial infarction; a chest pain score ≥ 10 points (hazard ratio (HR) 2.5, 95%CI 1.2 to 5.6, P = 0.02), ≥ 2 chest pain episodes in last 24 hours (HR 2.2, 95% CI 1.2 to 4.2, P = 0.01), age ≥ 67 years (HR 2.3, 95% CI 1.2 to 4.4, P = 0.01), IDDM (HR 4.2, 95% CI 2.1 to 8.4, P = 0.0001), and prior PCI (HR 2.2, 95% CI 1.1 to 4.8, P = 0.04).

The study constructed a risk score from 5 variables which were shown to be independently related to the primary end point. The variables with similar HR (chest pain score ≥ 10, ≥ 2 chest pain episodes in the last 24 hours, age ≥ 67 years and prior PCI) were assigned a 1 point value. IDDM was assigned a 2 point value as the HR value was twice the HR value of the other variables. This risk score gave the following patient population distribution: 0 points: n=111 (17.2%), 1 point: n=198 (30.7%), 2 points: n=206 (31.9%), 3 points: n=103 (15.9%), 4 points: n=16 (2.5%), 5 points: n=11 (1.7%), 6 points: n=1 (0.2%). The study combined 4-6 points due to the low number of patients giving the distribution: 4-6 points: n=25 (4.3%). The study then distinguished the 5 points values as: very low-risk (0 points, primary end point = 0%), low-risk (1 points, primary end point = 3.1%), intermediate-risk (2 points, primary end point = 5.4%), high-risk (3 points, primary end point = 17.6%) and very high-risk (≥4 points, primary end point = 29.6%). These were statistically significant with a P = 0.00001. The differences between the groups were also significant (comparing very low-, low-, intermediate-risk to very high-risk P = 0.0001, P = 0.0001, P = 0.0001 respectively; comparing very low-, low-, intermediate-risk to high-risk P = 0.002, P = 0.0001, P = 0.0001 respectively).

The new risk score was then compared with calculated TIMI scores. The new risk score had an accuracy C index of 0.78 (P = 0.0001) compared with the TIMI score C index of 0.66 (P = 0.0001), and the accuracy of the new score was significantly greater compared with the TIMI score (P = 0.0002). The accuracy of both the new risk score and the TIMI score were tested for the secondary end point (death, MI or urgent revascularization at 14 days, which the TIMI score was originally designed for). The new risk score had a C index of 0.70 (P = 0.0001) and the TIMI score and a C index of 0.66 (P = 0.002) were correlated to the secondary end point but there was no significant difference (P = 0.1).

NB there is overlap of patients included in this study and the study Sanchis et al 2005, Heart J (Risk Stratification of Patients with Acute Chest Pain and Normal Troponin Concentrations).

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

Correct population

Internal Validity

Well covered

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Schillinger M;Sodeck G;Meron G;Janata K;Nikfardjam M;Rauscha F;Laggner AN;Domanovits H;

Acute chest pain--identification of patients at low risk for coronary events. The impact of symptoms, medical history and risk factors

Ref ID 735 Wiener klinische Wochenschrift pgs: 83 to 89 2004

Study Type Cohort **Funding** Not reported

Number of participant	1288 patients
Inclusion/Exclusion Criteria	Inclusion criteria: all patients presenting with acute chest pain, onset in previous 24 hours, at a non-trauma emergency department
Patient Characteristics	The mean age of the population was 49±17 years, 41% were women, 29% had hypertension, 9% had diabetes mellitus, 35% had hyperlipidaemia, 32% were current smokers, 26% were obese (BMI>28), 20% had a family history of MI, 15% had a history of prior MI, 23% had a history of coronary artery disease, 2% had a history of congestive heart failure, 3% had valvular heart disease
Recruitment	Patients presenting with chest pain at a non-trauma emergency department
Setting	University hospital in Helsinki, Finland
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	Seven pre-defined criteria are evaluated and were assigned as either typical or atypical
Length of Study/ Follow-up	6 months
Outcome measures studied	Prediction or exclusion of acute MI and major adverse coronary events (MACE) at six months
Results	Seven pre-defined criteria are evaluated and were assigned as either typical or atypical; namely, location of chest pain (typical: left sided, atypical: right sided), character of pain (typical: crushing / sneezing / burning / tightness, atypical: stabbing / single spot / superficial), radiation (typical to the left or both arms, neck, back, atypical: not radiating), appearance of chest pain (typical: exercise induced / undulating / relieved with rest or nitroglycerin, atypical: inducible by pressure / abrupt palpitations / sustained / position dependent / respiration dependent / cough dependent), vegetative signs (typical dyspnea / nausea / diaphoreis atypical: absence of vegetative signs), history of coronary artery disease (typical: MI / PTCA / CABD, atypical: none) and risk factors for coronary artery disease namely; smoking, obesity, hypertension, diabetes, hyperlipidemia, and family history all typical, atypical was defined as absence or only one risk factor. The positive predictive value (PPV) and LR of typical and atypical criteria were evaluated for prediction or exclusion of acute MI and major adverse coronary events (MACE) at six months. Thirteen percent (168 patients) of patients had an acute MI and 19% (240 patients) had a MACE (CVD, percutaneous coronary interventions, bypass surgery or MI) at six months follow up. See narrative for question 1; Table 5: Schillinger et al, 2004 From the typical symptoms or history the likelihood ratios (LR) to predict an MI were: 1 typical symptom or history LR = 1.15; 2 typical symptoms and/or history LR = 1.32; 3 typical symptoms and/or history LR = 1.48; 4 typical symptoms and/or history LR = 1.77; 5 typical symptoms and/or history LR = 1.88; 6 typical symptoms and/or history

LR = 1.85
From the typical symptoms or history the LR to predict a cardiac adverse event in the following 6 months were:
1 typical symptom or history LR = 1.15; 2 typical symptoms and/or history LR = 1.34; 3 typical symptoms and/or history LR = 1.58; 4 typical symptoms and/or history LR = 1.87; 5 typical symptoms and/or history LR = 2.11; 6 typical symptoms and/or history LR = 1.54

See narrative for question 1; Table 5: Schillinger et al, 2004
From the atypical symptoms or history the LR to exclude an MI were:
1 atypical symptom or history LR = 1.05; 2 atypical symptoms and/or history LR = 1.25; 3 atypical symptoms and/or history LR = 1.76; 4 atypical symptoms and/or history LR = 2.22; 5 atypical symptoms and/or history LR = 3.19; 6 atypical symptoms and/or history LR = 3.00
From the atypical symptoms or history the LR to exclude a cardiac adverse event in the following 6 months were:
1 atypical symptom or history LR = 1.04; 2 atypical symptoms and/or history LR = 1.29; 3 atypical symptoms and/or history LR = 1.85; 4 atypical symptoms and/or history LR = 3.02; 5 atypical symptoms and/or history LR = 4.87; 6 atypical symptoms and/or history LR = 4.58

The presence of four or more typical criteria was associated with a PPV of 0.21 (95%CI 0.17 to 0.25) to predict acute MI and 0.30 (95% CI 0.25 to 0.35) for 6 month MACE. Increasing numbers of atypical chest pain criteria was associated with increasing PPVs for excluding acute MI and 6 month MACE. The presence of four or more typical criteria was associated with a PPV of 0.94 (95%CI 0.92 to 0.96) to exclude acute MI and 0.93 (95% CI 0.90 to 0.96) for 6 month absence of MACE. The authors concluded that the evaluation of criteria atypical for MI may identify patients suitable for early discharge; however criteria typical of MI have little diagnostic value

Safety and adverse effects

None reported

Does the study answer the question?

The presence of four or more typical criteria was associated with a PPV of 0.21 (95%CI 0.17 to 0.25) to predict acute MI and 0.30 (95% CI 0.25 to 0.35) for 6 month MACE. Increasing numbers of atypical chest pain criteria was associated with increasing PPVs for excluding acute MI and 6 month MACE. The presence of four or more typical criteria was associated with a PPV of 0.94 (95%CI 0.92 to 0.96) to exclude acute MI and 0.93 (95% CI 0.90 to 0.96) for 6 month absence of MACE. The authors concluded that the evaluation of criteria atypical for MI may identify patients suitable for early discharge; however criteria typical of MI have little diagnostic value

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

Correct population

Internal Validity

Well covered

Schillinger M;Sodeck G;Meron G;Janata K;Nikfardjam M;Rauscha F;Laggner AN;Domanovits H;

Acute chest pain--identification of patients at low risk for coronary events. The impact of symptoms, medical history and risk factors

Ref ID 735 Wiener klinische Wochenschrift pgs: 83 to 89 2004

Study Type Cohort **Funding** Not reported

Number of participant

1288 patients

Inclusion/Exclusion Criteria

Inclusion criteria: all patients presenting with acute chest pain, onset in previous 24 hours, at a non-trauma emergency department

Patient Characteristics	The mean age of the population was 49±17 years, 41% were women, 29% had hypertension, 9% had diabetes mellitus, 35% had hyperlipidaemia, 32% were current smokers, 26% were obese (BMI>28), 20% had a family history of MI, 15% had a history of prior MI, 23% had a history of coronary artery disease, 2% had a history of congestive heart failure, 3% had valvular heart disease
Recruitment	Patients presenting with chest pain at a non-trauma emergency department
Setting	University hospital in Helsinki, Finland
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	Seven pre-defined criteria are evaluated and were assigned as either typical or atypical
Length of Study/ Follow-up	6 months
Outcome measures studied	Prediction or exclusion of acute MI and major adverse coronary events (MACE) at six months
Results	Seven pre-defined criteria are evaluated and were assigned as either typical or atypical; namely, location of chest pain (typical: left sided, atypical: right sided), character of pain (typical: crushing / sneezing / burning / tightness, atypical: stabbing / single spot / superficial), radiation (typical to the left or both arms, neck, back, atypical: not radiating), appearance of chest pain (typical: exercise induced / undulating / relieved with rest or nitroglycerin, atypical: inducible by pressure / abrupt palpitations / sustained / position dependent / respiration dependent / cough dependent), vegetative signs (typical dyspnea / nausea / diaphoreis atypical: absence of vegetative signs), history of coronary artery disease (typical: MI / PTCA / CABD, atypical: none) and risk factors for coronary artery disease namely; smoking, obesity, hypertension, diabetes, hyperlipidemia, and family history all typical, atypical was defined as absence or only one risk factor. The positive predictive value (PPV) and LR of typical and atypical criteria were evaluated for prediction or exclusion of acute MI and major adverse coronary events (MACE) at six months. Thirteen percent (168 patients) of patients had an acute MI and 19% (240 patients) had a MACE (CVD, percutaneous coronary interventions, bypass surgery or MI) at six months follow up. See narrative for question 2; Table 1: Schillinger et al, 2004 From the typical symptoms or history the likelihood ratios (LR) to predict an MI were: 1 typical symptom or history LR = 1.15; 2 typical symptoms and/or history LR = 1.32; 3 typical symptoms and/or history LR = 1.48; 4 typical symptoms and/or history LR = 1.77; 5 typical symptoms and/or history LR = 1.88; 6 typical symptoms and/or history LR = 1.85 From the typical symptoms or history the LR to predict a cardiac adverse event in the following 6 months were: 1 typical symptom or history LR = 1.15; 2 typical symptoms and/or history LR = 1.34; 3 typical symptoms and/or history LR = 1.58; 4 typical symptoms and/or history LR = 1.87; 5 typical symptoms and/or history LR = 2.11; 6 typical symptoms and/or history LR = 1.54 See narrative for question 2; Table 1: Schillinger et al, 2004 From the atypical symptoms or history the LR to exclude an MI were: 1 atypical symptom or history LR = 1.05; 2 atypical symptoms and/or history LR = 1.25; 3 atypical symptoms and/or history LR = 1.76; 4 atypical symptoms and/or history LR = 2.22; 5 atypical symptoms and/or history LR = 3.19; 6 atypical symptoms and/or history LR = 3.00 From the atypical symptoms or history the LR to exclude a cardiac adverse event in the following 6 months were: 1 atypical symptom or history LR = 1.04; 2 atypical symptoms and/or history LR = 1.29; 3 atypical symptoms and/or history LR = 1.85; 4 atypical symptoms and/or history LR = 3.02; 5 atypical symptoms and/or history LR = 4.87; 6 atypical symptoms and/or history LR = 4.58 The presence of four or more typical criteria was associated with a PPV of 0.21 (95%CI 0.17 to 0.25) to predict acute MI and 0.30 (95% CI 0.25 to 0.35) for 6 month

	MACE. Increasing numbers of atypical chest pain criteria was associated with increasing PPVs for excluding acute MI and 6 month MACE. The presence of four or more typical criteria was associated with a PPV of 0.94 (95%CI 0.92 to 0.96) to exclude acute MI and 0.93 (95% CI 0.90 to 0.96) for 6 month absence of MACE. The authors concluded that the evaluation of criteria atypical for MI may identify patients suitable for early discharge; however criteria typical of MI have little diagnostic value
Safety and adverse effects	None reported
Does the study answer the question?	The presence of four or more typical criteria was associated with a PPV of 0.21 (95%CI 0.17 to 0.25) to predict acute MI and 0.30 (95% CI 0.25 to 0.35) for 6 month MACE. Increasing numbers of atypical chest pain criteria was associated with increasing PPVs for excluding acute MI and 6 month MACE. The presence of four or more typical criteria was associated with a PPV of 0.94 (95%CI 0.92 to 0.96) to exclude acute MI and 0.93 (95% CI 0.90 to 0.96) for 6 month absence of MACE. The authors concluded that the evaluation of criteria atypical for MI may identify patients suitable for early discharge; however criteria typical of MI have little diagnostic value
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Question 3: What is the diagnostic utility of pain relief with nitrates in the identification of patients with acute chest pain of cardiac origin.

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Steele R;McNaughton T;McConahy M;Lam J;

Chest pain in emergency department patients: if the pain is relieved by nitroglycerin, is it more likely to be cardiac chest pain?

Ref ID 7099 CJEM: The Journal of the Canadian Association of Emergency Physicians pgs: 164 to 170 2006

Study Type Diagnostic **Funding** Not stated

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

The study directly addresses the question of the diagnostic value of nitroglycerin pain relief.
The sensitivity of nitroglycerin as a diagnostic test was 72% (95% CI 64% to 80%). The specificity was 37% (95% CI 34% to 41%). The positive likelihood was 1.1 (95% CI 0.96 to 1.34). Nitroglycerin as a diagnostic tool was not found to be statistically significant in differentiating between patients with and without cardiac chest pain (using Pearson statistic, P = 0.12)

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Patient population directly applicable, patients with chest pain of suspected cardiac origin.

Internal Validity

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Diercks DB;Boghos E;Guzman H;Amsterdam EA;Kirk JD;

Changes in the numeric descriptive scale for pain after sublingual nitroglycerin do not predict cardiac etiology of chest pain

Ref ID 983 Annals of Emergency Medicine 45(6):581-5, pgs: to 2005

Study Type Diagnostic

Funding Stated that the authors did not receive any outside funding or support.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

The primary outcome of cardiac-related chest pain was found in 122 patients (18%), of which 68 had acute MI and 54 had unstable angina. An initial pain score of > 5 was documented in 478 patients (71%), and in this group the primary outcome of cardiac-related chest pain was found in 82 patients (17%). An initial pain score of equal to or less than 5 was documented in 186 patients (29%), and in this group the primary outcome of cardiac-related chest pain was found in 40 patients (17%).

In the total patient population, 125 (19%) patients had no change in pain, 206 (31%) patients had minimal pain reduction, 145 (22%) had moderate pain reduction, and 188 (28%) patients had significant or complete pain reduction. A change in the numeric descriptive scale score was not associated with a diagnosis of coronary artery disease in any of these 4 subgroups (using Pearson statistic = 1.0, P = 0.76). The study shows that nitroglycerin pain relief is not a useful diagnostic tool for identifying cardiac-related chest pain.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? Patient population directly applicable, patients with chest pain of suspected cardiac origin.

Internal Validity

Henrikson CA;Howell EE;Bush DE;Miles JS;Meininger GR;Friedlander T;Bushnell AC;Chandra-Strobos N;

Chest pain relief by nitroglycerin does not predict active coronary artery disease

Ref ID 7172 Ann Intern Med pgs: 979 to NaN 2003

Study Type Diagnostic

Funding National Heart, Lung and Blood Institute Training grant for CA Henrikson, USA.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? The study is directly applicable to the question of the utility of nitroglycerin pain relief in the diagnosis of chest pain of cardiac origin.
The sensitivity and specificity of chest pain relief with nitroglycerin for the presence of active coronary artery disease were 35% and 58%, respectively. The positive and negative likelihood ratios were 0.85 and 1.4, respectively. Further analysis was conducted in 3 pre-specified subgroups for chest pain relief with nitroglycerin for the presence of active coronary artery disease. For troponin negative patients the sensitivity, specificity, positive likelihood ratio and negative likelihood ratio were 39%, 58%, 0.88 and 1.1, respectively. For patients with a history of coronary artery disease the sensitivity, specificity, positive likelihood ratio and negative likelihood ratio were 30%, 63%, 0.84 and 1.3, respectively. For patients with no history of coronary artery disease, the sensitivity, specificity, positive likelihood ratio and negative likelihoods were 40%, 56%, 0.87 and 1.1, respectively. ROC curves were constructed for chest pain relief by nitroglycerin and active coronary artery disease. For ROC curves of both reduction in pain intensity and absolute changes in pain intensity the plotted points closely approximated to a likelihood of 1.0. Hence regardless of which definition is used, either percentage chest pain reduction or absolute pain reduction, the test of chest pain with nitroglycerin has no value in determining the presence or absence of coronary artery disease.

Effect due to factor in study?

Consistency of results with other studies?	
Directly applicable to guideline population?	Patient population directly applicable, patients with chest pain of suspected cardiac origin.
Internal Validity	

Grading: 2-	Case–control or cohort studies with a high risk of confounding bias, or chance and a significant risk that the relationship is not causal*

Shry EA;Dacus J;Van De GE;Hjelkrem M;Stajduhar KC;Steinhubl SR;

Usefulness of the response to sublingual nitroglycerin as a predictor of ischemic chest pain in the emergency department

Ref ID 7214 Am J Cardiol pgs: 1264 to 1267 2002

Study Type Diagnostic **Funding** Not stated.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

The study was conducted retrospectively, hence, it is open to selection bias. With this caveat, it provides information on the diagnostic utility of nitrogyicerin in diagnosing chest pain of cardiac origin.

Ninety percent, 199 out of 223 patients responded to nitroglycerin (at least a 2 unit reduction in chest pain based on the 10 point scale). Of the patients diagnosed with chest pain attributable to coronary artery disease, 88% responded to nitroglycerin, while 92% of the non cardiac chest pain group responded to nitroglycerin. Seventy percent of patients (52 out of 74 patients) with cardiac chest pain had complete pain resolution with nitroglycerin versus 73% of patients (108 out of 149 patients) with non cardiac chest pain had complete resolution (P = 0.85)

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Patient population directly applicable, patients with chest pain of suspected cardiac origin.

Question: 4 Are the symptoms and description of the symptoms different in women presenting with acute chest pain of suspected cardiac origin compared with men

Grading: 1+ Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias

Canto JG;Goldberg RJ;Hand MM;Bonow RO;Sopko G;Pepine CJ;Long T;

Symptom presentation of women with acute coronary syndromes: myth vs reality

Ref ID 25372 Arch Intern Med pgs: 2405 to 2413 2007

Study Type Systematic Review **Funding** Not reported

Number of participant	Cohort, Surveys, Registries.
Inclusion/Exclusion Criteria	Cohort, Surveys, Registries identified between 1970 to 2005
Patient Characteristics	Patients with ACS
Recruitment	Systematic review identified nine large cohort studies, and twenty smaller cohort or personal interview studies that provided information on ACS presentation with and without chest pain or discomfort according to sex
Setting	Emergency departments
Interventions/ Test/ Factor being investigated	Not applicable
Comparisons	Signs and symptoms, men versus women
Length of Study/ Follow-up	Not applicable
Outcome measures studied	
Results	Compared with men, 8 identified studies found that women are more likely to experience middle or upper back pain, 4 studies found that women are more likely to have neck pain, and 2 studies found that women are more likely to have jaw pain. Five studies found that women are more likely to have shortness of breath and five studies showed women are more likely to have nausea or vomiting. Loss of appetite, weakness and fatigue, and cough were identified as more common in women versus men in two studies each. Paroxysmal nocturnal dyspnea, indigestion and dizziness were reported as more common in women versus men in one study each. One study found that women appear to have a greater number of associated symptoms as part of their ACS presentation compared with men.
Safety and adverse effects	Not applicable
Does the study answer the question?	Yes. Women are significantly less likely to report chest pain or discomfort at presentation for ACS compared with men from accumulated data from 29 identified studies. The authors identified the following limitations of the review and other related studies; there is a lack of standardisation on data collection and reporting on women's principal or associated ACS symptoms thus formal meta-analyses was not possible due to heterogeneity, a number of studies exclude patients that have ACS and no chest pain or discomfort, chest pain or discomfort is often lumped together with pain localised to other areas of the upper body in the absence of chest pain symptoms, hospital records are often very imprecise in characterising the presence of chest pain, as well as other associated symptoms, physician bias based on the patients pre-test probability in recording symptoms, survey bias when patients recollect symptoms retrospectively, the sensitivity of a particular symptom may be ascertained but the specificity of a symptom may not be considered, and the impact of potential association of co-morbid conditions (such as diabetes), with symptom

	presentation has not been examined in the review due to the lack of currently available data although this is likely to be important.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Directly applicable to the guideline
Internal Validity	Well covered

Patel H;Rosengren A;Ekman I;

Symptoms in acute coronary syndromes: Does sex make a difference?

Ref ID 2613 Am Heart J pgs: 27 to 33 2004

Study Type	Systematic Review	**Funding**	In part: Vardal institute research platform

Number of participant	Systematic review- 15 cohort studies identified
Inclusion/Exclusion Criteria	Studies from a search between 1980 to 2002
Patient Characteristics	Fifteen studies were identified, four cohorts were in patients with all types of ACS and eleven cohorts were in patients with MI. The systematic review did not however provide a definition of ACS that was detailed in the selected studies.
Recruitment	Not applicable
Setting	Emergency departments
Interventions/ Test/ Factor being investigated	Signs and symptoms
Comparisons	Signs and symptoms; men versus women
Length of Study/ Follow-up	Not applicable
Outcome measures studied	Signs and symptoms in ACS patients
Results	Yes. Analysis of the 4 studies identified in patients presenting with ACS found that women are more likely to experience back and jaw pain, nausea and / or vomiting, dyspnea, indigestion and palpitations compared with men. In the 4 ACS cohort studies no gender difference was found for the following symptoms; presence of chest pain (2 studies), arm and shoulder pain (2 studies), neck pain (2 studies), dizziness (3 studies). Analysis of the eleven cohort studies identified in patients with MI found that women are more likely to have back, jaw, and neck pain, and nausea and / or vomiting, dyspnea, palpitations, indigestion, dizziness, fatigue, loss of appetites and syncope. The following symptoms were not associated with gender differences in the presentation of acute MI; arm and shoulder pain (4 studies), epigastric discomfort, heartburn or abdominal pain (7 studies), throat pain (2 studies)
Safety and adverse effects	Not applicable
Does the study answer the question?	Cohort studies suggest that women exhibit different symptoms of ACS versus men, however, here was inconsistency in the gender-specific symptoms reported, in that no individual symptom was identified by all studies that examined the symptom. It is likely that the baseline characteristics of the populations varied, and the authors

	stated that sex differences may disappear after controlling for variables such as age or co-morbid conditions. Some studies evaluated only a small number of symptoms, and may have missed other statistically significant symptoms.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Directly relevant to guideline population
Internal Validity	Adequately addressed

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Chrysohoou C;Panagiotakos DB;Pitsavos C;Kokkinos P;Marinakis N;Stefanadis C;Toutouzas PK;

Gender differences on the risk evaluation of acute coronary syndromes: The CARDIO2000 study

Ref ID 3520 Preventive Cardiology pgs: 71 to 77 2003

Study Type	Cohort	**Funding**	Not reported

Number of participant	848 patients (701 men, 147 women) and 1078 in the control group (862 men, 216 women)
Inclusion/Exclusion Criteria	Inclusion: first event of acute MI as diagnosed by 2 or more of following; ECG, compatible clinical symptoms, enzyme elevations, or first diagnosis of unstable angina as described by class III of the Braunwald classification
Patient Characteristics	Seven hundred and one (82%) of the cardiac patients were men with a mean age 59 SD 10 years, and 147 (18%) of cardiac patients were women with a mean age of 65.3 SD 8 years. For controls 80% were men and 20% were women with mean ages of 58.8 SD 10 years and 64.8 SD 10 years, respectively
Recruitment	Random selection of patients admitted between January 2000 and August 2001 who met the inclusion criteria. The control group were selected from patients who attended the hospital for routine outpatient appointments who were cardiovascular disease free.
Setting	Secondary Care, Greece
Interventions/ Test/ Factor being investigated	Risk factors for diagnosis ACS
Comparisons	Smoking, hypertension, hypercholesterolemia, diabetes, family history of premature CAD, BMI, physical activity, diet, alcohol consumption
Length of Study/ Follow-up	Not applicable
Outcome measures studied	Risk factors for diagnosis ACS
Results	Women experiencing their first cardiac event were significantly older than men (P < 0.01). Univariant analysis found that women were significantly more likely to have hypertension, hypercholesterolemia and diabetes, whereas men were significantly more likely to smoke, do physical activity and have higher alcohol consumption. This difference was found in both the cardiac patient group and the control group. When adjusting for age, multivariate analysis found that for women hypertension was associated with a higher risk of coronary artery disease compared with men (odds ratio 4.86 versus 1.66 P < 0.01, respectively). Family history of coronary artery disease and hypercholesterolemia were associated with a higher risk of coronary artery disease in men than in women with odds ratios of 5.11 versus 3.14, P < 0.05 for family history, respectively, and odds ratios of 3.77 versus 2.19 P < 0.05 for hypercholesterolemia, respectively.
Safety and adverse effects	Not applicable
Does the study answer the question?	Yes. Study found that impact of CAD is different for women versus men.. Men were more likely to have a family history of CAD and hypertension. Women were more likely to have hypertension compared with men.
Effect due to factor in study?	Yes

Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Not unselected chest pain population, however ACS I population is subset of this, therefore cohort is applicable as subset of the chest pain guideline population
Internal Validity	Well covered

Isaksson RM;Holmgren L;Lundblad D;Brulin C;Eliasson M;

Time trends in symptoms and prehospital delay time in women vs. men with myocardial infarction over a 15-year period. The Northern Sweden MONICA Study

Ref ID 25380 EUR J CARDIOVASC NURS pgs: 152 to 158 2008

Study Type Cohort

Funding Norrbotten County Council provided funding for the myocardial registry

Number of participant	6342 patients (5072 men and 1470 women).
Inclusion/Exclusion Criteria	Patients with a diagnosis of MI according to standard WHO definition. Exclusion criteria were patients in the registry with incomplete data
Patient Characteristics	Patients with MI according to standard WHO definition
Recruitment	Not applicable
Setting	Northern Swedish registry survey
Interventions/ Test/ Factor being investigated	Symptom presentation and prehospital delay and risk stratification according to age and gender
Comparisons	Age and gender, with respect to symptoms of MI
Length of Study/ Follow-up	Records over 15 years
Outcome measures studied	Signs and symptoms, hospital delay
Results	The study found that men were more likely to experience typical pain based on the MONICA criteria compared with women (86.3% versus 80.8%, respectively). Symptoms were also analysed with stratification for age and gender. A greater proportion of younger men (age group 25 to 34 years) had typical pain compared with older male age groups, and with increasing age a greater proportion of men experienced typical symptoms. For women, a lower proportion experienced typical symptoms compared with men in all age ranges, however in the age range 65 to 74 years the difference in proportion of men versus women with typical symptoms was less marked (79.8% versus 78.0%), hence in the oldest age group the frequency of atypical pain is similar in men and women. The study analysed prehospital delay in seeking medial attention according to age and gender (from < 2 h to > 24 h). For the total male population compared with the female population, there was no difference in the proportions in time to hospital delay; < 2 h, 41.2% men versus 41.2% women, < 4 h, 20.2% men versus 19.8% women, < 4 to 24 h, 27.7% men versus 29.8% women, and < 24 h, 10.9% men versus 9.8% women. Analysis of prehospital delay by stratifying according to age and gender found that there was no consistent difference with gender, although for the oldest age group of 65 to 74 years the delay was greater for women compared with men, 25% of older men delayed for more than 4 h compared with 31% for women.

Safety and adverse effects	Not applicable
Does the study answer the question?	Yes. Study found that typical pain was more common in men than in women with MI, hence women were more likely to experience atypical symptoms. Up to age 65 years there was no gender difference in time between onset of symptoms of MI and medical presence, thereafter women sought medical attention later than men.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Not unselected chest pain population, however MI population is subset of this, therefore cohort is applicable as subset of the chest pain guideline population
Internal Validity	Not addressed

Kosuge M;Kimura K;Ishikawa T;Ebina T;Hibi K;Tsukahara K;Kanna M;Iwahashi N;Okuda J;Nozawa N;Ozaki H;Yano H;Nakati T;Kusama I;Umemura S;

Differences between men and women in terms of clinical features of ST-segment elevation acute myocardial infarction

Ref ID 25382 Circulation Journal pgs: 222 to 226 2006

Study Type Cohort **Funding** Not reported

Number of participant	457 patients (106 women and 351 men)
Inclusion/Exclusion Criteria	Inclusion patients with STEMI with symptom onset within 24 h of admission to the coronary care unit and detailed medical history. Acute MI defined as elevation of greater than 2 mmm at least 2 contiguous precordal leads or ST elevation of greater than 1 mm in at least 2 inferior leads (II, III, or a VF), and a typical increase in serum creatine kinase.
Patient Characteristics	Patients with STEMI within 24 h after symptom onset, 457 patients (106 women and 351 men)
Recruitment	Consecutive recruitment from a coronary care unit
Setting	Coronary care unit in Japan
Interventions/ Test/ Factor being investigated	Signs and symptoms, and risk factors
Comparisons	Men versus women, signs and symptoms and risk factors
Length of Study/ Follow-up	Not applicable
Outcome measures studied	Location of pain, nausea, shortness of breath, risk factors
Results	The study found that women were older than men (72 versus 62 years, respectively, P < 0.001), had higher rates of hypertension (51% versus 38%, respectively, P = 0.017), diabetes (36% versus 26%, respectively, P = 0.047) and hyperlipidaemia (51% versus 38%, respectively, P = 0.019). Women were also likely to experience atypical symptoms compared with men. For women versus men, pain was more common in the jaw (9% versus 3%, respectively P = 0.047) throat and neck (13% versus 5%, respectively P = 0.007), left shoulder, left arm, forearm and / or hand (12% versus 5%, respectively P = 0.024) and back (24% versus 12%, respectively P = 0.047). Women were also more likely to experience milder pain compared with men (20% versus 7%, respectively P > 0.001), and nausea (49% versus 36%, respectively P = 0.047), vomiting (25% versus 15%, respectively P = 0.08), and shortness of

	breath (62% versus 52%, respectively P = 0.07). Coronary angiography showed that there was no difference in the severity of coronary artery lesions between men and women, although in hospital mortality was significantly higher in women than in men (6.6% versus 1.4%, respectively P = 0.003).
Safety and adverse effects	Not applicable
Does the study answer the question?	Yes. Study found that women have atypical presentation of STEMI compared with men, and higher rates of hypertension, diabetes and hyperlipidaemia compared with men.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Not unselected chest pain population, however STEMI population is subset of this, therefore cohort is applicable as subset of the chest pain guideline population
Internal Validity	Adequately addressed

Grading: 2-	Case–control or cohort studies with a high risk of confounding bias, or chance and a significant risk that the relationship is not causal*

Chua TP;Saia F;Bhardwaj V;Wright C;Clarke D;Hennessy M;Fox KM;

Are there gender differences in patients presenting with unstable angina?

Ref ID 1204 International journal of cardiology pgs: 281 to 286 2000

Study Type	Cohort	**Funding**	Not reported

Number of participant	313, 210 (67%) men, 103 (33%) women
Inclusion/Exclusion Criteria	Patients transferred to St Georges Hospital London UK, with a view to coronary angiography and further management, during a 42 month period (January 1994-January 1997)
Patient Characteristics	The mean age for men was 61.6±11 years, for women 63.5±10.5 years (P=0.14). 184 men were Caucasian, 23 were Asian (Indian subcontinent) and 3 had other ethnic origin. 83 women were Caucasian, 15 were Asian (Indian subcontinent) and 5 had other ethnic origin (P=0.4)
Recruitment	Patients transferred to tertiary care unit
Setting	St Georges Hospital, London, UK
Interventions/ Test/ Factor being investigated	Gender differences in patients presenting with unstable angina
Comparisons	Retrospective review of case notes of risk factors for men and women referred for coronary angiography and further care
Length of Study/ Follow-up	Review of case notes
Outcome measures studied	Differences in risk factors for men and women with unstable angina
Results	The mean age was 61.6±11 years for men and 63.5±10.5 for women (P=0.14) 184 men were Caucasian, 23 were Asian (Indian subcontinent) and 3 had other ethnic origin. 83 women were Caucasian, 15 were Asian (Indian subcontinent) and 5 had other ethnic origin (P=0.4) 51% of men and 39% of women had a history of previous MI (P=0.06) 76% of men and 79% of women had angina pectoris (P=0.73) Time to seeking help: < 1 day - 23% men, 28% women; 1-7 days - 38% men, 33% women; > 1 week: 39% men, 39% women 17% of men and 6% of women had had a previous coronary artery bypass graft operation (P=0.013) 56% of men and 64% of women had hypercholesterolemia (P=0.23) The mean total serum cholesterol concentration was 6.4±1.6 mmol/l in men and 6.7±1.5 mmol/l in women, (P=0.4) 42% of men and 49% of women had a family history of ischaemic heart disease (P=0.28) 11% of men and 23% of women had diabetes mellitus (P=0.007) 32% of men and 52% of women had a history of hypertension (P=0.001) 73% of men and 46% of women were current or previous smokers (P=0.00001) 25% of men and 40% of women were current smokers (P=0.06) The study also considered the management of patients, a similar number of men and women underwent coronary artery bypass graft operation and coronary angioplasty.
Safety and adverse effects	Not applicable

Does the study answer the question?	The results found that more men than women with unstable angina were referred for coronary angiography reflecting the higher prevalence of ischaemic heart disease in men. There was no significant difference between men and women in age, the ratio of Caucasian to non-Caucasian patients, past history of angina pectoris, the duration of time before seeking medical help, mean total serum cholesterol level, family history of ischaemic heart disease. The prevalence of hypercholesterolemia was higher in women but it was not significant. Women were more likely to have diabetes mellitus, a history of hypertension and to currently smoke. Men were more likely to have a history of previous MI, history of previous coronary artery bypass graft operation and a history of smoking. The study also considered the subsequent management of patients, and showed that the subsequent management of patients was not influenced by their gender. A similar proportion of male and female patients underwent coronary artery bypass graft operation and coronary angioplasty.
Effect due to factor in study?	Highly selected population from a tertiary care centre and recruitment not detailed, and also retrospective therefore risk of bias.
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Not unselected chest pain population, however unstable angina population is subset of this, therefore cohort is applicable as subset of the chest pain guideline population
Internal Validity	Not addressed

Question: Are the symptoms and description of the symptoms different in Black and Ethnic Minorities presenting with acute chest pain of suspected cardiac origin compared with Caucasians

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Johnson PA;Lee TH;Cook EF;Rouan GW;Goldman L;

Effect of race on the presentation and management of patients with acute chest pain.[see comment]

Ref ID 25397 Ann Intern Med pgs: 593 to 601 1993

Study Type Cohort **Funding** Not reported

Number of participant	Final study population was 3031 after exclusions
Inclusion/Exclusion Criteria	Inclusion: patients presenting to the emergency department with a chief complaint of anterior, percordial, or left lateral chest pain that could not be explained by obvious local trauma or abnormalities on a chest X ray. Patients that experienced cardiac arrest in the emergency department were excluded from the study. During the study period, 4173 potentially eligible patient visits occurred, and the final study population was 3031 after exclusions (11 due to incomplete data, 531 consent not obtained, 204 inadequate follow-up, 158 race not identified, and 238 as race was Asian or Hispanic).
Patient Characteristics	Of 3031 patients included, 1374 (45%) were African American and 1657 (55%) were Caucasian with mean age of 53 years and 58 years, respectively (P < 0.001). The African American patients were significantly more likely to be female compared with Caucasian patients (68% versus 47%, respectively P < 0.0001), and less likely to have a past history of; coronary artery disease (30% versus 47%, respectively, P < 0.0001), cardiac catheterisation (6% versus 11%, respectively P < 0.0001), and coronary artery bypass surgery (3% versus 11%, respectively, P < 0.0001). African Americans compared with Caucasians were less likely to have a final diagnosis of acute MI (6% versus 12%, respectively, P < 0.0001), and this result is consistent given the prior history findings of African American patients versus Caucasian patients.
Recruitment	patients presenting to the emergency department with a chief complaint of anterior, percordial, or left lateral chest pain that could not be explained by obvious local trauma or abnormalities on a chest X ray.
Setting	Emergency department USA, Dec 1983 to Oct 1988
Interventions/ Test/ Factor being investigated	History, risk factors and signs and symptoms
Comparisons	African Americans versus Caucasians with suspected acute MI
Length of Study/ Follow-up	Not applicable
Outcome measures studied	History, risk factors and signs and symptoms
Results	African American patients with a final diagnosis of acute Ml had similar presenting signs and symptoms compared with the Caucasian patients. Comparing the two racial groups clinical characteristics of acute M I, the odds ratios were all greater than 1.0 for chest pain greater than or equal to 30 min, pressure type chest pain, radiation of pain to left arm, left shoulder, neck or jaw, diaphoresis and rales on physical examination for both racial groups but these were not statistically different between the groups. While it was found that African American patients were less likely to have a final diagnosis of acute MI (P < 0.0001), there was no longer a statistical association with race and acute MI after adjustments for were made for presenting signs and symptoms using logistical regression analysis. The odds ratio for acute MI outcomes for African Americans compared with Caucasians was 0.77 (95% CI 0.54 to 1.1).

Safety and adverse effects	Not applicable
Does the study answer the question?	Yes, African Americans had a similar clinical presentation of acute MI compared with Caucasians
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Acute chest pain population therefore directly applicable
Internal Validity	Adequately addressed

Klingler D;Green WR;Nerenz D;Havstad S;Rosman HS;Cetner L;Shah S;Wimbush F;Borzak S;

Perceptions of chest pain differ by race

Ref ID 10300 Am Heart J pgs: 51 to 59 2002

Study Type Cohort

Funding National Institute of Aging, the National Institute of Nursing Research and the Office of Minority Health of the NIH

Number of participant	215 in total, 157 African American, 58 white
Inclusion/Exclusion Criteria	Patients admitted with suspected acute MI. Patients were included if English was their primary language and they could recall pre-hospital events. Patients were excluded if they were of a race other than African American or Caucasian, were aged < 18 years, had known mental impairment, were pregnant, had a MI subsequent to admission, had a previous interview prior to admission, or had significant emergency data missing from their medical records.
Patient Characteristics	Mean age - 59±14 years African American, 62±15 years white (P=0.13) Male – 46% African American, 57% white (P=0.15)
Recruitment	Patients who were admitted with acute MI between April 1999 and August 1999 to the ED chest pain unit
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Comparison of Medical history and risk factors between African American and white patients with acute MI
Comparisons	Medical history and risk factors of African American and white patients
Length of Study/ Follow-up	Not reported
Outcome measures studied	Medical history and risk factors
Results	Characteristics: Mean age - 59±14 years African American, 62±15 years white (P=0.13) Male – 46% African American, 57% white (P=0.15) Diabetes – 28% African American, 16% white (P=0.05) Hypertension – 67% African American, 55% white (P=0.12) Hypercholesterolemia – 28% African American, 34% white (P=0.5) Angina – 8% African American, 3% white (P=0.37) Heart attack – 27% African American, 16% white (P=0.06) Congestive heart failure – 12% African American, 12% white (P=0.99)

Coronary angiography – 15% African American, 10% white (P=0.4)
Coronary artery bypass graph – 8% African American, 21% white (P=0.01)
Smoker – 29% African American, 31% white (P=0.74)
Prior stomach complaints – 16% African American, 29% white (P=0.03)

Symptoms:
Cardiac
Chest pain – 78% African American, 79% white (P=0.88)
Chest pressure – 62% African American, 76% white (P=0.06)
Chest tightness – 51% African American, 58% white (P=0.37)
Chest discomfort – 64% African American, 59% white (P=0.5)
Palpitations – 40% African American, 26% white (P=0.07)
Any of the above – 97% African American, 93% white (P=0.16)
Gastrointestinal
Stomach pain – 22% African American, 17% white (P=0.47)
Heartburn – 26% African American, 21% white (P=0.41)
Indigestion – 26% African American, 22% white (P=0.58)
Gas pain – 33% African American, 28% white (P=0.49)
Stomach problem – 22% African American, 19% white (P=0.59)
Any of the above – 57% African American, 59% white (P=0.86)
Associated symptoms
Nausea/vomiting – 44% African American, 41% white (P=0.74)
Arm/shoulder pain – 41% African American, 38% white (P=0.68)
Back pain – 30% African American, 33% white (P=0.69)
Jaw pain – 12% African American, 12% white (P=0.9)
Headache – 37% African American, 29% white (P=0.29)
Neck pain – 29% African American, 28% white (P=0.86)
Numbness/tingling – 33% African American, 32% white (P=0.96)
Shortness of breath – 62% African American, 60% white (P=0.85)
Cough – 38% African American, 26% white (P=0.09)
Dizziness – 54% African American, 48% white (P=0.5)
Sweating – 50% African American, 53% white (P=0.68)
Weakness/fatigue – 68% African American, 60% white (P=0.29)

There was no significant difference in the one worst reported symptom (respiratory, cardiac, gastrointestinal, other, unable to identify) between African American and white patients. There was also no significant difference in the location of pain (above diaphragm, below diaphragm, both, other), the timing of the pain (constant, intermittent, wax/wane) and the median discomfort and control of pain between African American and white patients.

Safety and adverse effects

Not applicable

Does the study answer the question?

Patients were interviewed from April 1999 to August 1999. Patients were identified through a floor census and screened through a brief review of their medical charts. Patients were approached to participate based on their medical record number. 215 met the inclusion criteria out of 588 who were approached.
A structured questionnaire was developed to assess the contextual, emotional and behavioural factors in patients seeking medical help. The questionnaire was adapted from existing questionnaires, after external validation by a group of experts it was piloted on 10 patients and altered accordingly.

Demographics and medical history:
27% were white and 73% were African American, there were no significant differences between the two groups' age, sex and insurance status (suggestive of socioeconomic status).
African Americans were significantly more likely to have diabetes (P=0.05) and to be taking calcium-channel blockers (P=0.005), however white patients were more likely to have had coronary artery bypass surgery (P=0.01) and to have had a previous stomach complaint (P=0.03).

Symptoms at presentation:
Those who were diagnosis as not having an MI were more likely to have had stomach pain (P=0.03) and sweating (P=0.05) at presentation. No significant differences were found between African American and white patients in the objective symptoms. There was no significant difference in the one worst reported symptom (respiratory, cardiac, gastrointestinal, other, unable to identify) between African American and white patients. There was also no significant difference in the location of pain (above diaphragm, below diaphragm, both, other), the timing of the pain

	(constant, intermittent, wax/wane) and the median discomfort and control of pain between African American and white patients. African Americans were as likely as Caucasian patients to report typical objective symptoms but were marginally more likely to attribute their symptoms to a gastrointestinal source rather than a cardiac source (P = 0.05). Of 157 Caucasian patients, 11 patients were diagnosed as having had an MI (11%), while 27 out of 58 Caucasian patients (47%) were diagnosed with acute MI (P < 0.001). However of those patients with a final diagnosis of MI, 61% of African Americans attributed their symptoms to a gastrointestinal source and 11% to a cardiac source versus 26% and 33%, respectively for Caucasian patients.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Acute chest pain population therefore directly applicable
Internal Validity	Not addressed

Maynard C;Beshansky JR;Griffith JL;Selker HP;

Causes of chest pain and symptoms suggestive of acute cardiac ischemia in African-American patients presenting to the emergency department: a multicenter study

Ref ID 1424 Journal of the National Medical Association pgs: 665 to 671 1997

Study Type	Cohort	**Funding**	Agency for Health Care Policy and Research

Number of participant	10001, of which 3401 (34%) were African Americans,, 6600 were white
Inclusion/Exclusion Criteria	Included: aged greater or equal to 30 years presenting with chest or left arm pain, shortness of breath, or other symptoms suggestive of acute cardiac ischemia from 10 participating hospitals in east and midwest USA. Excluded: patients with chest pain/ discomfort related to trauma, surgical emergencies, those with a clear non-cardiac cause, patients transferred from other hospitals
Patient Characteristics	In the male group, the average age for African American patients was 52±14 years and 60±15 year for white patients (P<0.0001). The average time from symptom onset to emergency department arrival was 3 hours for African American patients and 2 hours for white patients (P=0.0006). 33% of African American men and 15% of white men were uninsured, 23% of African American men and 6% of white men had Medicaid, 28% of African Americans men and 44% of white men had Medicare; for all P <0.0001 (measure of socio economic status). In the female group, the average age for African American patients was 55±15 years and 65±16 year for white patients (P <0.0001). The average time from symptom onset to emergency department arrival was 3.3 hours for African American patients and 3 hours for white patients (P=0.045). 26% of African Americans women and 12% of white women were uninsured, 24% of African Americans and 8% of white women had Medicaid, 33% of African Americans women and 56% of white women had Medicare; for all P <0.0001 (measure of socio economic status).
Recruitment	Patients admitted to 10 hospitals in east and midwest USA
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	If race is determinant in diagnosing acute MI or angina
Comparisons	African Americans and white patients

Length of Study/ Follow-up	Not reported
Outcome measures studied	Signs and symptoms and risk factors to diagnose acute MI or angina
Results	Medical History and Clinical Characteristics Men Ulcer – 16% African American, 16% white (P=0.74) Hypertension – 57% African American, 44% white (P=<0.0001) Angina – 29% African American, 42% white (P=<0.0001) MI – 20% African American, 35% white (P=<0.0001) Stroke – 9% African American, 8% white (P=0.47) Diabetes – 20% African American, 20% white (P=0.88) Current smoker – 56% African American, 30% white (P=<0.0001) Cardiac medications – 47% African American, 59% white (P=<0.0001) Chest pain – 77% African American, 75% white (P=0.20) Chest pain as primary symptom – 69% African American, 70% white (P=0.49) Shortness of breath – 62% African American, 51% white (P=<0.0001) Abdominal pain – 20% African American, 12% white (P=<0.0001) Nausea – 28% African American, 24% white (P=0.01) Vomiting – 13% African American, 7% white (P=<0.0001) Dizziness – 35% African American, 26% white (P=<0.0001) Fainting – 6% African American, 7% white (P=0.32) Rales – 19% African American, 20% white (P=0.14) S3 sound – 4% African American, 3% white (P=0.013) Congestive heart failure – 16% African American, 16% white (P=0.65) Systolic blood pressure >160 – 21% African American, 23% white (P=0.29) Diastolic blood pressure >90 – 36% African American, 28% white (P=<0.0001) Women Ulcer – 14% African American, 14% white (P=0.73) Hypertension – 64% African American, 51% white (P=<0.0001) Angina – 32% African American, 39% white (P=<0.0001) MI – 18% African American, 26% white (P=<0.0001) Stroke – 9% African American, 9% white (P=0.85) Diabetes – 32% African American, 23% white (P=<0.0001) Current smoker – 34% African American, 24% white (P=<0.0001) Cardiac medications – 60% African American, 64% white (P=0.01) Chest pain – 79% African American, 72% white (P=<0.0001) Chest pain as primary symptom – 69% African American, 64% white (P=0.0002) Shortness of breath – 61% African American, 55% white (P=<0.0001) Abdominal pain – 17% African American, 13% white (P=<0.0001) Nausea – 35% African American, 29% white (P=<0.0001) Vomiting – 14% African American, 10% white (P=<0.0001) Dizziness – 33% African American, 26% white (P=<0.0001) Fainting – 5% African American, 7% white (P=0.001) Rales – 19% African American, 25% white (P=<0.0001) S3 sound – 3% African American, 3% white (P=0.74) Congestive heart failure – 15% African American, 18% white (P=0.019) Systolic blood pressure >160 – 28% African American, 28% white (P=0.45) Diastolic blood pressure >90 – 34% African American, 23% white (P=<0.0001)
Safety and adverse effects	Not applicable
Does the study answer the question?	The study found that there were differences in patients' medical history dependant upon racial background. African Americans were more likely to smoke and have hypertension compared with Caucasians, and African American women were more likely to have diabetes than Caucasian women. Caucasian patients were more likely to have a history of angina or MI and to take cardiac medications. There was no difference in the number of African Americans and Caucasian male patients who had chest pain as a primary symptom. There were a higher number of African American female patients than Caucasian female patients who had chest pain as a primary symptom. African American patients were more likely to report additional symptoms of shortness of breath, abdominal pain, nausea, vomiting and dizziness. African Americans were more likely to have a diastolic blood pressure of > 90mmHg when admitted to hospital compared to Caucasian patients, and the authors stated that this is consistent with the finding of more previous systemic hypertension in African Americans.

	Acute MI and angina was less likely to be diagnosed in African American men compared with Caucasian men (acute MI; 6% versus 12%, respectively; angina 8% compared to 20%). Non cardiac diagnoses were confirmed in almost half of African American men compared with one third of Caucasian men. Similarly only 4% of African American women had a final diagnosis of acute MI compared with 8% in Caucasian women, and angina was diagnosed in 12% of African American women compared with 17% of Caucasian women. Non cardiac diagnoses were confirmed in almost half of African American women compared with 39% of Caucasian women. Logistic regression in 74% of the patients examined the racial differences in the diagnoses, using the following variables; medical history, sociodemographic factors, signs and symptoms, and the hospital the patient was admitted to. African American patients compared to Caucasian patients were half as less likely to develop acute MI (odds ratio 0.54, 95% CI 0.41 to 0.68).
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients with chest pain, left arm pain, shortness of breath or symptoms suggestive of acute cardiac ischeamia, directly applicable.
Internal Validity	Not addressed

Teoh M;Lalondrelle S;Roughton M;Grocott-Mason R;Dubrey SW;

Acute coronary syndromes and their presentation in Asian and Caucasian patients in Britain

Ref ID 25394 Heart pgs: 183 to 188 2007

Study Type	Cohort	**Funding**	Listed as none
Number of participant	2905 patients, 604 (21%) were Asian and 2301 (79%) were Caucasian		
Inclusion/Exclusion Criteria	Consecutive patients requiring hospital admission for ACS recruited by a senior cardiac nurse. Patients of races other than Asian or Caucasian were excluded		
Patient Characteristics	Asians mean age 60.6 (SD 12.7) years, Caucasians 68.9 (SD 13.9) years (P < 0.001), Asians 66% male, Caucasians 62%		
Recruitment	Consecutive by nurse in emergency department		
Setting	Emergency department UK		
Interventions/ Test/ Factor being investigated	Signs and symptoms, risk factors		
Comparisons	Asians versus Caucasian		
Length of Study/ Follow-up	Not applicable		
Outcome measures studied	Signs and symptoms, risk factors		
Results	Frontal upper body discomfort was reported by 94% of Asian patients versus 89% of Caucasian patients (P < 0.001), while almost twice as many Asian patients reported pain on the rear of their body compared with Caucasian patients (46% versus 25%, respectively, P < 0.001). The character of the discomfort as described by the Asian patients was 'weight' (34%), followed by 'squeeze' (28%), and 'ache' (14%). For Caucasian patients the most common term was 'weight' (28%), followed by 'ache' (23%), and 'squeeze' (20%).		

	There was a small but statistically significant difference in the intensity of discomfort reported, with Asian patients reporting a median pain rating of 7.5 compared with 7.0 in Caucasian patients (P < 0.002). Twenty four percent of Asian patients rated their discomfort at the maximum value of 10 compared with 19% of Caucasian patients. A smaller percentage of Asian patients (6%) reported feeling no discomfort at presentation (silent MI) compared with Caucasian patients (13%) (P = 0.002). These patients were identified by a combination of symptoms, including fatigue, shortness of breath, collapse and resuscitation following cardiac arrest. Logistic regression analysis was performed to determine which factors contributed to patients reporting a silent episode, and the most significant factor was a patients diabetic status, they were more than twice as likely to report that they felt no pain during presentation compared with non-diabetics (odds ratio 2.08, 95% CI 1.56 to 2.76). Analysis showed that Caucasian patients (odds ratio 1.61, 95% CI 1.08 to 1.10) were also more likely to feel no discomfort compared with Asian patients. Analysis with age as a continuous variable was also associated with silent episode.
Safety and adverse effects	Not applicable
Does the study answer the question?	Yes. Asian patients were younger, more likely to be diabetic and they tended to report greater intensity of pain over a greater area of the body, and more frequent discomfort over the rear of their upper thorax than Caucasian patients.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Acute chest pain population therefore directly applicable
Internal Validity	Not addressed

Grading: 2-	Case–control or cohort studies with a high risk of confounding bias, or chance and a significant risk that the relationship is not causal*

Barakat K;Wells Z;Ramdhany S;Mills PG;Timmis AD;

Bangladeshi patients present with non-classic features of acute myocardial infarction and are treated less aggressively in east London, UK

Ref ID 10302 Heart pgs: 276 to 279 2003

Study Type Cohort

Funding K.Barakat is supported by an MRC Clinical Training Fellowship

Number of participant	371 patients, of which 108 were Bangladeshi and 263 were white
Inclusion/Exclusion Criteria	Patients who were white or Bangladeshi with acute MI. Inclusion criteria was acute MI as defined by the presence of cardiac chest pain with ST elevation > 1 mm in two consecutive leads, Q wave development, and a creatine kinase rise greater than twice the upper limit of normal (400 IU/ml).
Patient Characteristics	The mean age was 63±12 years in the Bangladeshi group and 68 ±19years in the white group (P<0.0001). 87% of the Bangladeshi group were male compared to 70% of the white group (P0.002). 1/3 of the Bangladeshi patients were fluent in English
Recruitment	Patients admitted to Royal London Hospital, UK, acute MI between May 1998 and April 2001
Setting	Royal London Hospital, UK
Interventions/ Test/ Factor being investigated	Bangladeshi patients compared to white patients with acute MI
Comparisons	Bangladeshi patients compared to white patients
Length of Study/ Follow-up	Not reported
Outcome measures studied	Risk factors, symptoms
Results	Baseline characteristics: Age (years) – Bangladeshi 63±12; Whites 68±19 (P<0.0001) Male sex – 87% Bangladeshi; 70% Whites (P=0.002) Smoking – 71.3% Bangladeshi; 70.3% Whites (P=0.85) Hypertension – 43.5% Bangladeshi; 38.4% Whites (P=0.36) Diabetes – 50% Bangladeshi; 15.2% Whites (P<0.0001) Family history of IHD – 13% Bangladeshi; 29.3% Whites (P=0.0005) Previous acute MI – 28.7% Bangladeshi; 48% Whites (P=0.0014) Nature of chest pain and interpretation of symptoms by racial group: (Bangladeshi n-32, Whites n=31) Central pain – 40.6% Bangladeshi, 87.1% White (P=0.0006) Left sided pain – 34.4% Bangladeshi, 3.2% White (P=0.0006) Other pain – 25% Bangladeshi, 97% White (P=0.0006) Typical character of pain – 25% Bangladeshi, 58.1% White (P=0.0132) Non-classical character of pain – 75% Bangladeshi, 41.9% White (P=0.0132) Interpreted as acute MI– 46.9% Bangladeshi, 45.2% White (P=0.99) Interpreted as other– 53.1% Bangladeshi, 54.8% White (P=0.99) Initial response of sought health care advice – 46.9% Bangladeshi, 25.8% White (P=0.20) Initial response of sought family advice – 37.5% Bangladeshi, 61.3 White (P=0.20) Initial response of other – 15.6% Bangladeshi, 12.9% White (P=0.20)

	(typical character is: heaviness, tightness, weight, pressure, band-like, gripping; non-classical character is: sharp, stabbing, pinching, burning) Multivariate analysis of the likelihood of Bangladeshi patients to present with typical central chest pain compared with white patients: Crude – (OR 0.11; 95% CI 0.03 to 0.38; P=0.0006) Adjustment for age and sex – (OR 0.10; 95% CI 0.03 to 0.39; P=0.0007) Adjustment for age, sex and diabetes – (OR 0.12; 95% CI 0.03 to 0.49; P=0.0031) Adjustment for age, sex, diabetes, hypertension, smoking, family history of IHD and hypercholesterolemia – (OR 0.11; 95% CI 0.02 to 0.58; P=0.0094) Adjustment for age, sex, diabetes, hypertension, smoking, family history of IHD, hypercholesterolemia and proficiency in English – (OR 0.10; 95% CI 0.01 to 0.79; P=0.0285) Multivariate analysis of the likelihood of Bangladeshi patients to present with typical cardiac chest pain compared with white patients: Crude – (OR 0.25; 95% CI 0.09 to 0.74; P=0.0118) Adjustment for age and sex – (OR 0.25; 95% CI 0.08 to 0.77; P=0.0154) Adjustment for age, sex and diabetes – (OR 0.19; 95% CI 0.05 to 0.70; P=0.0124) Adjustment for age, sex, diabetes, hypertension, smoking, family history of IHD and hypercholesterolemia – (OR 0.13; 95% CI 0.03 to 0.63; P=0.0116) Adjustment for age, sex, diabetes, hypertension, smoking, family history of IHD, hypercholesterolemia and proficiency in English – (OR 0.05; 95% CI 0.004 to 0.46; P=0.0091)
Safety and adverse effects	Not applicable
Does the study answer the question?	The baseline characteristics of the study showed that Bangladeshis were younger, more often male and diabetic, and more likely to report a previous acute MI than Whites. However Bangladeshis were less likely to report a family history of ischaemic heart disease than whites. 1/3 of the Bangladeshi patients were assessed to be fluent in English. Bangladeshis were significantly less likely to report central chest pain (OR 0.11; 95% CI 0.03 to 0.38; P=0.0006) than whites. This significant difference remained after adjustment for difference in age, sex, risk factor profiles and fluency in English. Bangladeshis were also were more likely to offer non-classic descriptions (sharp, stabbing, pinching, burning) and less likely to report classic descriptions of the character of pain (heaviness, tightness, weight, pressure, band-like, gripping) (OR 0.25; 95% CI 0.09 to 0.74; P=0.0118). These differences persisted after adjustment for difference in age, sex, risk factor profiles and fluency in English. The study concluded that Bangladeshi patients with an acute MI were more likely to present with atypical symptoms compared to white patients. The Authors stated that this may lead to slower triage in the emergency department and delay in treatment, this factor needs recognition by emergency department staff in order to reduce mortality rates in this high risk group.
Effect due to factor in study?	Not certain- selected patients with chest pain, hence directness to question may be inappropriate as in that patients with atypical symptoms not necessary included
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Selected patients with chest pain, hence directness to question may be inappropriate as in that patients with atypical symptoms not necessary included
Internal Validity	Not addressed

Question 6: What is the utility (incremental value) and cost effectiveness of the resting ECG in evaluation of individuals with acute chest pain of suspected cardiac origin?

Grading: 1++ High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias

Mant J;McManus RJ;Oakes RL;Delaney BC;Barton PM;Deeks JJ;Hammersley L;Davies RC;Davies MK;Hobbs FR;

Systematic review and modelling of the investigation of acute and chronic chest pain presenting in primary care

Ref ID 728 Health technology assessment pgs: 1 to 158 2004

Study Type Systematic Review

Funding NHS R&D Health Technology Assessment Programme

Number of participant In total fifty three cohorts

Inclusion/Exclusion Criteria Papers with patients with acute and stable chest pain of suspected cardiac origin

Patient Characteristics Patients with acute and stable chest pain of suspected cardiac origin

Recruitment

Setting Primary and secondary care

Interventions/ Test/ Factor being investigated Resting ECG. Diagnosis of acute MI and ACS.

Comparisons

Length of Study/ Follow-up

Outcome measures studied Diagnosis of acute MI, ACS and angina.

Results The presence of ST elevation (commonly defined as 1 mm in at least two contiguous limb leads or 2 mm in two contiguous precordial leads) was the most discriminating single ECG for ruling in a diagnosis of acute MI in patients with acute chest with a positive LR of 13.1 (95% CI 8.28 to 20.60, P < 0.001). A completely normal ECG was reasonably useful at ruling out a MI (LR+ 0.14, 95%CI 0.11 to 0.20, P = 0.007) in patients with acute chest pain. The two next best changes were the presence of Q waves (LR + 5.01, 95% 3.56 to 7.06) and ST depression (LR + 3.13, 95% 2.50 to 3.92). Reasonable discrimination of MI was possible when a number of features were combined, for example ST elevation, depression Q waves/ and or T waves (LR + 5.30 95%CI 3.66 to 7.70) (see Table 1). A completely normal ECG was reasonably useful at ruling out a MI (LR+ 0.14, 95%CI 0.11 to 0.20). It was stated that the summary results were difficult to interpret because of significant heterogeneity in the studies but that a single ECG was an important for diagnostic information in the evaluation of acute chest pain. A further number of studies were identified that examined ECG in addition to some or all of the following evaluations that had been used in the emergency department: signs, symptoms, and investigations. These were defined as 'black box' studies. There were fifteen studies evaluating real time decision making on the initial information available to physicians. Analysis of black box studies was divided into 4 subgroups; interpretation of admission ECG for MI and acute coronary syndrome, interpretation of clinical data other than ECG, A&E initial diagnosis for MI and acute coronary syndrome, and A&E decisions to admit for MI and acute coronary syndromes. Clinical interpretation of admission ECG studies showed that there was a very high LR+ (145 in the best quality paper) for ruling in an MI, however the sensitivity was low (LR- 0.58). The one study that examined the exclusive use of signs and symptoms in diagnosis found that clinical evaluation was not helpful. For the studies evaluating A&E initial diagnosis for MI gave a LR+ of 4.48 (95% CI 2.82 to 7.12) and a LR- of 0.29 (95% CI 0.18 to 0.49). For the category of A&E decisions to

	admit for MI the LR+ was 2.55 (95% CI 1.87 to 3.47) with an LR–. Of 0.08 (95% CI 0.05 to 0.18). ECG was not found to be particularly useful in ruling in a diagnosis of angina in patients with stable chest pain. Thirteen studies were identified and the presence of Q wave changes was found to be the most frequently evaluated ECG change. The LR+ was 2.56, however the 95% CI interval was wide (0.86 to 7.30). ST segment plus or minus T wave changes were not found to be useful. The absence of any ECG changes was not helpful
Safety and adverse effects	None reported
Does the study answer the question?	
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	

Grading: 1+	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias

Ioannidis JP;Salem D;Chew PW;Lau J;

Accuracy and clinical effect of out-of-hospital electrocardiography in the diagnosis of acute cardiac ischemia: a meta-analysis

Ref ID 198 Ann Emerg Med pgs: 461 to 470 2001

Study Type Systematic Review **Funding** Not reported

Number of participant 8 prospective and retrospective cohort studies

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

The review considered prospective and retrospective English language papers published between 1966 and December 1998 on the diagnostic accuracy of out-of-hospital ECG. 8 of the studies considered the diagnostic accuracy for AMI and 5 of the studies considered the diagnostic accuracy of acute cardiac ischemia (ACI).

See Narrative question3; Table 4: Ioannidis et al, 2001
The studies identified found that out-of hospital ECGs for AMI have a diagnostic odds ratio (OR) of 104 and 95% CI 48 to 224 and for ACI OR of 23 and 95% CI 6.3 to 85. The review reported that there was significant heterogeneity in the sensitivity and specificity results between the 8 studies which was possibly due to the difference in definition of an abnormal ECG. The review identified one study which compared computer interpreted ECG with physician interpreted ECG and showed the computer interpreted ECG had a better specificity (98% versus 95%) but a worse sensitivity (52% versus 66%) when compared to physician interpreted ECG. The review states that the diagnostic accuracy may be affected by the expertise interpreting the ECG but states that even experienced clinicians can miss a diagnosis.

The review concluded there was substantial data to show that out-of-hospital ECGs have similar diagnostic accuracy as standard ECGs for AMI and ACI. The authors suggest that an out-of-hospital ECG should be considered by paramedics in all chest pain patients.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Morrison LJ;Brooks S;Sawadsky B;McDonald A;Verbeek PR;

Prehospital 12-lead electrocardiography impact on acute myocardial infarction treatment times and mortality: a systematic review

Ref ID 555 Acad Emerg Med pgs: 84 to 89 2006

Study Type Systematic Review **Funding** Not stated

Number of participant	Cohort studies best available evidence
Inclusion/Exclusion Criteria	Included studies: advanced notification pre-hosital ECG comparisons with emergency room ECG as comparison.
Patient Characteristics	Suspected acute MI.
Recruitment	Systematic review: 5 studies cohort studies identified.
Setting	Ambulance and emergency department.
Interventions/ Test/ Factor being investigated	ECG
Comparisons	Pre hospital ECG versus emergency department ECG.
Length of Study/ Follow-up	One study reported mortality but this was not significant for pre hospital ECG versus emergency department ECG.
Outcome measures studied	Door to treatment time.
Results	The pre-hospital on scene time for acute MI was not significantly different when comparing these studies (total patient number of 519) (pooled weighted mean difference of 1.19 (95% CI –0.84 to 3.21). The door to treatment interval was compared for 181 patients and decreased with PHECG and advanced notification compared with no PHECG (mean weighted difference of 36.1 minutes (95% CI -63.0 to -9.327). However considered heterogeneity was found in these studies (Q statistic 10.9, P < 0.01). Only one study examined all cause mortality. There was no difference all cause mortality when PHECG was compared with no advanced notification for patients with acute MI (PHECG: 8.4% versus control: 15.5%, P < 0.22)
Safety and adverse effects	
Does the study answer the question?	Examines pre-hospital ECG recordings for accuracy with subsequent ECG in emergency department. Determines the accuracy of prehospital ECG in final diagnosis. Although not completely relevant to the ECG sensitivity / specificity in the diagnosis of coronary artery disease, informs on the setting of ECG.
Effect due to factor in study?	

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Aufderheide TP;Xue Q;Dhala AA;Reddy S;Kuhn EM;

The added diagnostic value of automated QT-dispersion measurements and automated ST-segment deviations in the electrocardiographic diagnosis of acute cardiac ischemia

Ref ID 1711 J Electrocardiol pgs: 329 to 339 2000

Study Type Cohort **Funding** Not reported

Number of participant	1568 ECGs
Inclusion/Exclusion Criteria	The patients were aged over 18, who sought paramedic evaluation for chest pain which was non-traumatic or equivalent syndrome of presumed cardiac origin and who were classed as stable (a systolic blood pressure of 90mmHg or more, absence of second- or third-degree heart block, ventricular fibrillation or ventricular tachycardia on initial examination). Patients were excluded if the paramedic thought a pre-hospital ECG would affect treatment, and if the ECG showed QRS duration, heart rate, atrial fibrillation or flutter, heat block, or fully paced rhythms
Patient Characteristics	The median age was 62 years and 45.3% were women
Recruitment	patients who had a prehospital ECG by paramedics
Setting	ambulance, USA
Interventions/ Test/ Factor being investigated	ECG diagnosis
Comparisons	ST segment, QT-end and QT-peak dispersion, physician and computer interpretation
Length of Study/ Follow-up	
Outcome measures studied	sensitivity, specificity, PPV and NPV of ECG
Results	See narrative question 3; tables 4, 5, 6, 7 Aufderheide et al, 2000 The study assessed the sensitivity and specificity of diagnosing AMI by assessment by both physicians of ST segment deviation, QT-end dispersion and QT-peak dispersion measurements independent of each other. The study showed the average sensitivity was 50.5% and specificity was 98%. The study went on to assess the sensitivity and specificity of diagnosing AMI by a computer through independent assessment of ST segment deviation, which showed a higher sensitivity of 90% but lower specificity of 56%. For independent assessment of QT-end and QT-peak dispersion the computer interpretation did not have a significant difference compared to the physicians' interpretation. The study went on to assess the sensitivity and specificity of diagnosing AMI when combining the information of QT-end and QT peak dispersions which showed that the physicians' significantly increased in sensitivity by 88% (90% versus 48%, P=<0.001), but decreased in specificity by 44% (55% vs. 99% P=<0.001) and PPV by 58% (40% vs. 95%, P=<0.001). The sensitivity and specificity were also assessed when ST segment deviation was included in the analysis, which showed this lead to the physicians' highest sensitivity 65% (compared to 48%, P=<0.001) and maintained specificity 97% (compared to 99%, P=<0.001) The study continued to assess the sensitivity and specificity of diagnosing ACI; the physicians' had a lower sensitivity (38-40%). The study assessed the sensitivity and specificity by assessment by both physicians and the computer of ST segment deviation, QT-end dispersion and QT-peak dispersion measurements independent of

	each other. For ST segment deviation the computer had a higher sensitivity (75%) but a lower specificity (66%). The study showed that for independent assessment of QT-end dispersion and QT-peak dispersion the computer had a higher sensitivity compared to the physicians (50-53% compared to 38-40%, P=<0.001), but the specificity, PPV and NPV were all comparable. The study went on to assess the sensitivity and specificity of diagnosing ACI when combining the information of QT-end and QT peak dispersions which showed that the physicians' significantly increased in sensitivity by 70% (65-68% versus %, P=<0.001) and NPV by 19% (68%-69% versus 58%, P=<0.001), but decreased in specificity (80-81% vs. 92% P=<0.001) and PPV (79% vs. 85%, P=<0.001). The sensitivity and specificity were also assessed when ST segment deviation was combined with QT-end dispersion, which showed this lead to the physicians' highest sensitivity 62% (compared to 40%, P=<0.001) and NPV to 68% (compared to 58%, P=<0.001) and maintained specificity 90% (compared to 92%, P=<0.001) and PPV 87% (compared to 85%, P=<0.05)
Safety and adverse effects	None reported
Does the study answer the question?	The study assessed the sensitivity and specificity of diagnosing AMI by assessment of ST segment deviation, QT-end dispersion and QT-peak dispersion measurements independent of each other. The study showed the computer interpretation had a higher sensitivity but lower specificity compared to physician interpretation. The study showed that when combining QT-end and QT-peak dispersion the physicians sensitivity increased but specificity and PPV decreased, when combining ST segment deviation as well the physicians' reached its maximum sensitivity and maintained specificity. The study assessed the sensitivity and specificity of diagnosing ACI by assessment of ST segment deviation, QT-end dispersion and QT-peak dispersion measurements independent of each other. The study showed the computer interpretation had a higher sensitivity but lower specificity compared to physician interpretation for ST segment deviation, and higher sensitivity but comparable specificity, PPV and NPV for QT-end and QT-peak. The study showed that when combining QT-end and QT-peak dispersion the physicians sensitivity and NPV increased but specificity and PPV decreased, when combining ST segment deviation and QT-end dispersion the physicians' reached its maximum sensitivity and NPV and maintained specificity and PPV.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients had chest pain
Internal Validity	Well covered

Conti A;Paladini B;Toccafondi S;Magazzini S;Olivotto I;Galassi F;Pieroni C;Santoro G;Antoniucci D;Berni G;

Effectiveness of a multidisciplinary chest pain unit for the assessment of coronary syndromes and risk stratification in the Florence area

Ref ID 926 American heart journal pgs: 630 to 635 2002

Study Type Cohort

Funding Italian Ministry for Scientific and Technological Research

Number of participant 13 762 patients

Inclusion/Exclusion Criteria Inclusion: over 18 years old, chest pain defined as pain in the thoracic region, independent of duration, radiation, or relation to exercise, occurring in the last 24 hours and lasting minutes to hours

Patient Characteristics	The mean age was 65±18 years and 43% were women Those who were categorised as being at high risk (21%) had a mean age of 63±10 years, 33% were female, 35% smoked, 25% had diabetes, 38% had hypertension, 13.4 % died during the follow up. Those who were categorised as being at intermediate risk (47%) had a mean age of 64±11 years, 38% were female, 33% smoked, 28% had diabetes, 41% had hypertension, 2.2 % died during the follow up. Those who were categorised as being at low risk (32%) had a mean age of 38±15 years, 66% were female, 12% smoked, 8% had diabetes, 22% had hypertension, 0.2 % died during the follow up.
Recruitment	Admitted to emergency department with chest pain as described above
Setting	ED. Careggi General Hospital, Florence, Italy
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score was based on: location of pain, radiation of pain, character of pain, history of angina
Length of Study/ Follow-up	6 months
Outcome measures studied	Effectiveness of chest pain score in diagnosing chest pain
Results	The chest pain score was based on the following elements each of which was given a value: location of pain: substernal or precordial = +3, left chest, neck, lower jaw or epigastrium = +1, apex = -1; radiation of pain: arm, shoulder, back, neck or lower jaw = +1; character of pain: crushing, pressing or heaviness = +2 sticking, pleuritic or pinprick = -1; associated symptoms: dyspnea, nausea or diaphoresis = +2; history of angina = +3. The mean age was 65±18 years. Patients were classified into 1 of 4 groups. 1) Patients at low risk with obvious noncardiac causes of chest pain, chest pain score <4, normal ECG, and normal serum markers of cardiac injury obtained at least 6 hours from symptoms, were sent home and followed up. (2672 patients) 2) Patients at low risk with chest pain score ≥ 4, normal ECG, normal serum cardiac markers, independent of age or coexisting coronary risk factors, were not admitted and underwent a second-line evaluation and short-term observation in the CPU area, including chest radiography, serial 12-lead ECG, serial troponins and cardiac enzymes, echocardiography and arterial blood gas analysis. When at least one of these tests or procedure results was found to be suggestive of AMI, unstable angina or CAD or left ventricular failure was detected these patients were considered for angiography with no additional testing. After an observation period up to 6 hours patients without ongoing cardiovascular events underwent exercise tolerance test or SPECT or stress echocardiography. (1755 patients) 3) Patients at intermediate risk with clinical score ≥ 4 and abnormal ECG (ST-segment elevation <1mm or ST-segment depression <1mm at 60ms from J point) were admitted and managed in the CPU area. 4) Patients at high risk with ECG suggestive for AMI (defined as ST elevation ≥1 mm at 60ms from J point, ≥2 contiguous leads) were directly transferred to the coronary care unit and patients with suspected major cardiovascular disease, such as aortic arch dissection, pulmonary embolism, pneumothorax and acute pericarditis, were admitted and managed with arterial blood gas analysis, chest radiography, echocardiography, and thorax computed tomography if required by clinical assessment. At six month follow up 0.2% of these patients were recognised as having nonfatal coronary artery disease, hence, the negative predictive value of a chest pain score of < 4 and normal ECG was > 99% Of the patients with a chest pain score ≥ 4 and normal or non diagnostic electrocardiogram results (1755 patients, 40%), 20% of the low risk group with chest pain score < 4 (group 1) (885 patients) had documented coronary artery disease, 18% of which were by recurrent angina, delayed ECG changes, late rise in markers, the other 2% was by positive stress test. There were 9335 intermediate and high risk patients, of which 2420 patients (26%) had an MI, 3764 patients (40%) had unstable angina, 129 (1.4%) had aortic

	dissection and 408 (4%) had pulmonary embolism, other major cardiovascular conditions were diagnosed, including aortic arch dissection, pulmonary embolism, pneumothorax, and acute pericarditis. 2256 patients had atypical chest pain diagnosed as multi-organ disease including chronic and stable ischemic heart disease, defined as known stable angina, previous myocardial infarction, or angiographically documented CAD
Safety and adverse effects	None reported
Does the study answer the question?	Of the patients with a chest pain score > 4 and normal electrocardiogram results, 20% (885 patients) had documented coronary artery disease. There were 9335 intermediate and high risk patients, of which 2420 patients (26%) had an MI, 3764 patients (40%) had unstable angina, 129 (1.4%) had aortic dissection and 408 (4%) had pulmonary embolism. Other multi-organ disease was found in 2256 patients. The authors concluded that the chest pain score screening programme was effective and could significantly reduce admissions and optimise the care of those with an intermediate or high risk score. The authors also concluded that the screening programme could aid the diagnosis of alternative causes of chest pain in patients who do not have evidence of coronary artery disease
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Fesmire FM;

Which chest pain patients potentially benefit from continuous 12-lead ST-segment monitoring with automated serial ECG?

Ref ID 6025 Am J Emerg Med pgs: 773 to 778 2000

Study Type	Cohort	**Funding**	Not reported
Number of participant	706 patients		
Inclusion/Exclusion Criteria	included: chest pain with suspected ACS		
Patient Characteristics	The average age for category II was 57.3±11.3 years, 67.2% were men, 89.8% were Caucasian, 10.2% were African American, 62% had previous MI, 52.3% had previous PTCA/CABG. The average age for category III was 54.6±12.9 years, 61% were men, 76.6% were Caucasian, 22.8% were African American, 31.5% had previous MI, 25.2% had previous PTCA/CABG. The average age for category IV was 52.6±14.4 years, 49% were men, 67.9% were Caucasian, 29.8% were African American, 21.6% had previous MI, 15.4% had previous PTCA/CABG		
Recruitment	Patients presented with chest pain of suspected ACS to the emergency department between August 1995 and August 1998		
Setting	Emergency department, USA		
Interventions/ Test/ Factor being investigated	Continuous ST segment monitoring		
Comparisons	Sensitivity and specificity of serial ECG		

Length of Study/ Follow-up	
Outcome measures studied	Sensitivity and specificity of serial ECG
Results	Patients had an initial history, physical examination and ECG, and were subsequently classed in four different categories. Category I were patients with ACS with clinical and ECG criteria for emergency reperfusion therapy, category II were patients with probable ACS but without clinical and ECG criteria for emergency reperfusion therapy, category III were patients with possible ACS, category IV were patients with probable non-ACS chest pain but presence of pre-existing disease or significant risk factors for CAD. Category I were excluded from the study. The serial ECG was obtained at least every 10 minutes until the patient was taken for PTCA or for 2 hours See narrative question 3; Table 10, 11, 12, 13: Fesmire, 2000 28 patients were placed in category I, 137 patients were placed in category II, 333 patients were placed in category III and 208 patients were placed in category IV. Table 1, 2, 3 and 4 show the results of the study. Serial ECG for new injury or new/evolving ischemia had a sensitivity and specificity of 41.7% (95% CI 27.6 to 58.6) and 98.1% (95% CI 96.7 to 99) respectively for AMI and 15.5% (95% CI 10.6 to 21.5) and 94.4% (95% CI 98.2 to 99.9) for ACS. For AMI the serial ECG had a positive likelihood ratio (LR+) of 21.9 and negative likelihood (LR-) of 0.59 and for ACS a LR+ of 25.4 and LR- of 0.85. As a result of the serial ECG 26 patients had their treatment changed
Safety and adverse effects	None reported
Does the study answer the question?	Serial ECG for new injury or new/evolving ischemia had a sensitivity and specificity of 41.7% (95% CI 27.6 to 58.6) and 98.1% (95% CI 96.7 to 99) respectively for AMI and 15.5% (95% CI 10.6 to 21.5) and 94.4% (95% CI 98.2 to 99.9) for ACS. For AMI the serial ECG had a positive likelihood ratio (LR+) of 21.9 and negative likelihood (LR-) of 0.59 and for ACS a LR+ of 25.4 and LR- of 0.85. As a result of the serial ECG 26 patients had their treatment changed
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients had chest pain with suspected ACS
Internal Validity	Well covered

Ohlsson M;Ohlin H;Wallerstedt SM;Edenbrandt L;

Usefulness of serial electrocardiograms for diagnosis of acute myocardial infarction

Ref ID 1582 The American journal of cardiology pgs: 478 to 481 2001

Study Type	Cohort	**Funding**	Swedish Medical Research Council, Swedish Heart Lung Foundation, Medical Faculty at Lund University, Swedish Foundation for Strategic Research

Number of participant	902 ECGs were reviewed, each ECG was also reviewed with a previous ECG for the same patient
Inclusion/Exclusion Criteria	ECG had to show an AMI, previous ECG had to be available from the clinical electrocardiographic database

Patient Characteristics	The average age of the patients was 74±11 years, with 605% being men
Recruitment	Patients with AMI who presented to emergency department between January 1990 and June 1997
Setting	Emergency department, Sweden
Interventions/ Test/ Factor being investigated	Usefulness of serial ECG
Comparisons	serial ECG versus single ECG, by a cardiologist, intern and computer
Length of Study/ Follow-up	
Outcome measures studied	accuracy of reading ECG
Results	The study recorded a 12 lead ECG by the use of computerized ECGs. During which the QRS duration, QRS area, Q, R and S amplitudes and 6 ST-T measurements (ST-J amplitude, ST slope, ST amplitude 2/8, ST amplitude 3/8, positive T amplitude and negative T amplitude) were recorded. For each measurement of the new ECG the same measurement was recorded from the previous ECG. The ECGs were interpreted for diagnosis AMI by artificial neutral network which used standard feed forward, multilayer, perceptron architecture, which consisted 1 input layer, 1 hidden layer and 1 output layer with 16 or 32 nodes, the ECGs were then interpreted independently by two physicians (one cardiologist and one intern), on two occasions, the first occasion only the new ECG was shown and the second occasion both ECGs were shown. The study used ROC curves to evaluate the difference in interpretation and diagnosis of AMI when both ECGs were present compared to only the current ECG. The ROC curve showed that the neutral network performance was improved when both ECGs were present (area under ROC with current ECG = 0.85, area under ROC with both ECGs = 0.88; P = 0.02). The intern performed better when both ECGs were present (area under ROC with current ECG = 0.71, area under ROC with both ECGs = 0.78; P < 0.001) and diagnosed more AMI with both ECGs. The cardiologist performance did not have a statistically significant improve with both ECGs (area under ROC with current ECG = 0.79, area under ROC with both ECGs = 0.81; P = 0.36)
Safety and adverse effects	None reported
Does the study answer the question?	The study used ROC curves to evaluate the difference in interpretation and diagnosis of AMI when both ECGs were present compared to only the current ECG. The ROC curve showed that the neutral network performance was improved when both ECGs were present, the intern performed better when both ECGs were present and diagnosed more AMI with both ECGs. The cardiologist performance did not have a statistically significant improve with both ECGs.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients had AMI
Internal Validity	Well covered

Sanchis J;BodÝ V;Llßcer A;N·±ez J;Consuegra L;Bosch MJ;Bertomeu V;Ruiz V;Chorro FJ;

Risk stratification of patients with acute chest pain and normal troponin concentrations

Ref ID 459 Heart (British Cardiac Society) pgs: 1013 to 1018 2005

Study Type Cohort	**Funding** Not reported
Number of participant	609 patients
Inclusion/Exclusion Criteria	Inclusion: Patients with chest pain of suspected cardiac origin as determined by a cardiologist on call with a negative troponin I concentration (measured at baseline, at 6, 8 and 12 hours). Exclusion: ST elevation, Left Bundle Branch Block, and heart failure, killip > 1
Patient Characteristics	The mean age was 64±12 years, 33% were women, 20% were current smokers, 59% had hypertension, 53% had hypercholesterolemia, 25% had diabetes, 44% had a history of IHD, 13% had a family history of IHD, 7% had had coronary surgery, 12% had ST depression, 9% had T wave inversion
Recruitment	Patients admitted to the emergency department in a teaching hospital in Spain
Setting	ED, teaching hospital in Spain
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score was based on: location, radiation, character, severity, what influenced the pain, associated symptoms, history of exertional angina. A clinical history, ECG and for those in the low risk group an early (<24 hours) exercise test
Length of Study/ Follow-up	6 months
Outcome measures studied	Effectiveness of chest pain score in diagnosing chest pain
Results	An ECG was recorded in the emergency room and evaluated for ST segment depression (>1mm) and T wave inversion (peak inversion >1mm) Troponin I concentrations were taken at arrival, 6 hours (is patient arrived within 2 hours of onset of pain), 8 hours and 12 hours after pain onset. All patients had normal troponin concentrations at each measurement. Patients underwent a chest pain score assessment, an ECG, and for those in the low risk group an early (<24 hours) exercise test. The chest pain score was based on: location, radiation, character, severity, influenced by glyceryl trinitrate, stature, breathing, associated symptoms and history of exertional angina = +3. A clinical history was also taken. During a 6 month follow up, 25 patients (4.1%) had an acute MI, 9 (1.5%) died of cardiac causes and 29 (4.8%) had a major event (AMI or cardiac death). Those who could had a negative exercise test had a very good prognosis compared to those who did not have a negative exercise test or those who could not exercise and do and exercise test. See narrative for question 3; Table 16: Sanchis et al, 2005, Heart See narrative for question 3; Table 17: Sanchis et al, 2005, Heart For predictors of AMI the univariate and multivariate analysis showed: ST segment depression (univariate P = 0.004, multivariate P = 0.02, odds ratio (OR) 2.9, 95%CI 1.2 to 6.8), T-wave inversion (univariate P = 0.5, multivariate analysis could not be applied to T-wave inversion). For predictors of a major event (AMI or cardiac death) the univariate and multivariate analysis showed: ST segment depression (univariate P = 0.003, multivariate P = 0.01, OR 2.8, 95%CI 1.3 to 6.3), T-wave inversion (univariate P = 0.7, multivariate analysis could not be applied to T-wave inversion). The patients were stratifies according to the four independent risk factors associated with a major event (AMI or cardiac death), these were chest pain score, diabetes, previous coronary surgery and ST-segment depression. The event rate increased with the number of risk factors: no risk factors 2.5% event rate, 1 risk factor 2.9% event rate, 2 risk factors 10.2% event rate, 3 or 4 risk factors 29.2% event rate. Three risk categories were defined: low risk: no or 1 risk factor 2.7% event rate,

	intermediate risk: 2 risk factors 10.2% event rate, high risk: 3 or 4 risk factors 29.2% event rate. The differences between the 3 categories were all significant: high and intermediate (P = 0.001), high and low (P = 0.0001), intermediate and low (P = 0.008).
Safety and adverse effects	None reported
Does the study answer the question?	During a 6 month follow up, 25 patients (4.1%) had an acute MI, 9 (1.5%) died of cardiac causes and 29 (4.8%) had a major event (AMI or cardiac death). Multivariate analysis found that ST segment depression was an independent factors in predicting an acute MI (univariate P = 0.004, multivariate P = 0.02, OR 2.9, 95%CI 1.2 to 6.8), and major events (AMI or cardiac death) (univariate P = 0.003, multivariate P = 0.01, OR 2.8, 95%CI 1.3 to 6.3). Further analysis found that the event rate increased progressively with the progression of the number of independent risk factors, with the event rate increasing with the number of risk factors: no risk factors 2.5% event rate, 1 risk factor 2.9% event rate, 2 risk factors 10.2% event rate, 3 or 4 risk factors 29.2% event rate. From this 3 risk categories, low intermediate and high, were formed with the difference between each being significant. NB there is overlap of patients included in this study and the study Sanchis et al 2005, JACC (New Risk Score for Patients with Acute Chest Pain, Non-ST-Segment Deviation, and Normal Troponin Concentrations).
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Sanchis J;BodÝ V;N·±ez J;Bertomeu G;G¾mez C;Bosch MJ;Consuegra L;Bosch X;Chorro FJ;LlÓcer A;

New risk score for patients with acute chest pain, non-ST-segment deviation, and normal troponin concentrations: a comparison with the TIMI risk score

Ref ID 447 Journal of the American College of Cardiology pgs: 443 to 449 2005

Study Type	Cohort	**Funding**	RECAVA-FIS

Number of participant	646 patients
Inclusion/Exclusion Criteria	Inclusion criteria: acute chest pain of possible cardiac origin Exclusion: if the initial ECG showed ST-segment deviation (≥1mm elevation or depression) or if they had troponin I elevation
Patient Characteristics	The mean age was 64±12 years and 32% were women. 20% were smokers, 59% had hypertension, 53% had hypercholesterolemia, 26% had diabetes mellitus, 7% insulin dependant diabetes mellitus, 12% had a family history of IHD, 13% had at least 3 risk factors, 24% had prior coronary stenosis ≥ 50%, 43% had used aspirin in the previous 7 days, 25% had a prior MI, 9% had prior PTCA, 8% had prior CABG, 2% had a history of heart failure. On ECG 100% had T-wave inversion,9% had confounding ECG
Recruitment	Patients admitted with acute chest pain to the emergency department in a teaching hospital in Spain during a 34 month period between 15th January 2001 and 30th November 2003
Setting	ED in a teaching hospital in Spain

Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score and other variables, described in results
Length of Study/ Follow-up	1 year
Outcome measures studied	The primary end point was all cause mortality or nonfatal myocardial infarction, the secondary end point was all cause mortality, nonfatal myocardial infarction or urgent revascularisation at 14 day follow up.
Results	Patients were excluded if they had ST-segment deviation (≥1mm elevation or depression) on the initial ECG or if they had troponin I elevation. All patients had T-wave inversion and 9% had confounding ECG (left branch bundle block of paced rhythm). An ECG was recorded in the emergency room. Troponin I concentrations were taken at arrival, 6 hours (is patient arrived within 2 hours of onset of pain), 8 hours and 12 hours after pain onset. All patients had normal troponin concentrations at each measurement. Patients underwent a chest pain score assessment based on: location, radiation, character, severity, influenced by glyceryl trinitrate, stature, breathing, associated symptoms and history of exertional angina. A clinical history and risk factor analysis was also taken. At 1 year follow up, the primary end point (all-cause mortality or non-fatal MI) occurred in forty three patients (6.3%). At a 14 day follow up, the secondary end point (all-cause mortality or nonfatal myocardial infarction or urgent revascularisation) occurred in 35 patients (5.4%). The univariate analysis showed that for: T-wave inversion (P = 0.4), confounding ECG (P = 0.09). The multivariate analysis showed that for: confounding ECG (P = 0.3). The multivariate analysis did not give results for T-wave inversion or full results for confounding ECG. The study showed from multivariate analysis ECG changes (T-wave inversion and confounding ECG) were not independent predictors of the primary end point.
Safety and adverse effects	None reported
Does the study answer the question?	Univariate analysis found that the following were independent factors in predicting all cause mortality or nonfatal myocardial infarction; t-wave inversion (P = 0.4), and confounding ECG (P= 0.09). Multivariate analysis found that ECG changes were not independent factors in predicting all cause mortality or nonfatal myocardial infarction. Confounding ECG on multivariate analysis (P=0.3). NB there is overlap of patients included in this study and the study Sanchis et al 2005, Heart J (Risk Stratification of Patients with Acute Chest Pain and Normal Troponin Concentrations).
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Question 7: What is the utility (incremental value) and cost effectiveness of a chest X ray in evaluation of individuals with chest pain of suspected cardiac origin?

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Pryor DB;Harrell FE;Lee KL;Califf RM;Rosati RA;

Estimating the likelihood of significant coronary artery disease

Ref ID 10283 The American journal of medicine pgs: 771 to 780 1983

Study Type Cohort **Funding** Not reported

Number of participant	3627 in training population, 1811 in test population
Inclusion/Exclusion Criteria	Patients with chest pain who were referred for cardiac catheterization at the Duke University Medical Center between November 1969 and January 1982
Patient Characteristics	Patient characteristics which were collected were: History: age, sex, chest pain history (pain type, severity, frequency, nocturnal, progressive, preinfarctional), duration of CAD, previous history of MI, congestive heart failure, history of vascular disease (Progressive chest pain - the frequency, severity or duration had increased in the 6 weeks prior to catherisation; Preinfarctional chest pain - a very unstable pain pattern that resulted in admission to the coronary care unit for evaluation of the possible MI) Risk factors: smoking, hyperlipidaemia, hypertension, diabetes, family history Physical examination: ventricular gallop, systolic blood pressure ECG: ST-T wave changes, electrocardiographic premature ventricular contractions, Electrocardiographic Q waves Chest X-Ray: cardiomegaly
Recruitment	Patients admitted for cardiac catheterisation between November 1969 and January 1982
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Chest pain diagnosis
Comparisons	Patient characteristics which give a probability of disease
Length of Study/ Follow-up	
Outcome measures studied	Probability of disease
Results	The study had a training population of 3627 patients who were seen between 1969 and January 1979, from these patients a stepwise logistic regression analysis was used to develop a model for predicting the probability of significant CAD. A test population of 1811 patients seen between January 1969 and January 1982, in this population the model developed in the test population was used to predict the probability of CAD for each patient. The authors then tested the model in other populations (from CASS study) to estimate the prevalence of disease in subgroups of the patients in the literature (external validation) Results from training population: Poor Clinical Predictors of Significant CAD and the Chi-squared: See narrative for question 4; Table 1:Pryor et al, 1983 Cardiomegaly: 1.41

	The results from the training group show that cardiomegaly shown on chest x-ray was a poor predictor of significant coronary artery disease The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence.The authors then externally validated using the population from the CASS study. There was disagreement on patients classified as having nonanginal chest pain (where the greatest difference in predicted disease compared to observed disease was seen), but the predicted estimates from the model were nearly equal to the observed prevalence of disease. The predicted estimates from the model of the probability of significant disease were nearly identical to the observed prevalence for subgroups based on “age, sex and history of MI” or “age, sex and pain type”.
Safety and adverse effects	None
Does the study answer the question?	Progressive chest pain was described as being chest pain when the frequency, severity or duration had increased in the 6 weeks prior to catherisation. Preinfarctional chest pain was described as chest pain with a very unstable pain pattern that resulted in admission to the coronary care unit for evaluation of the possible MI The results from the training group show that cardiomegaly shown on chest x-ray was a poor predictor of significant coronary artery disease (chi-square = 1.41). The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence. When comparing the model to an external population the study showed that the predicted estimates from the model were nearly equal to the observed prevalence of disease. The predicted estimates from the model of the probability of significant disease were nearly identical to the observed prevalence for subgroups based on “age, sex and history of MI” or “age, sex and pain type”. However the greatest difference in predicted disease compared to observed disease was seen in patients with nonanginal chest pain.
Effect due to factor in study?	Yes
Consistency of results with other studies?	No similar studies
Directly applicable to guideline population?	Patients had chest pain
Internal Validity	Well covered

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Pryor DB;Shaw L;McCants CB;Lee KL;Mark DB;Harrell FE;Muhlbaier LH;Califf RM;

Value of the history and physical in identifying patients at increased risk for coronary artery disease

Ref ID 1751 Annals of internal medicine pgs: 81 to 90 1993

Study Type Cohort

Funding Agency for Health Care Policy and Research, National Heart, Lung and Blood institute, National Library of Medicine

Number of participant	1030 patients, 168 had cardiac catheterization. At 3 years data for 973 patients (94%) was obtained.
Inclusion/Exclusion Criteria	Inclusion: Symptomatic patients, referred for non-invasive testing for suspected coronary artery disease Exclusion: previous cardiac catheterization
Patient Characteristics	The mean age was 55, 37% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 12 months, 28% had typical angina symptoms, 52% atypical angina symptoms, 20% nonanginal pain, 18% progressive angina, 22% nocturnal angina, 44% smoked, 41% had a history of hypertension, 10% had diabetes, 11% had hyperlipidemia, 35% had ST-T wave changes on ECG, 18% had a history of MI, 8% had Q waves on ECG, 14% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 3% had peripheral vascular disease, 3% had cerebral vascular disease Of the patients who went on to have a cardiac catheterization the mean age was 56, 31% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 7 months, 49% had typical angina symptoms, 47% atypical angina symptoms, 4% nonanginal pain, 24% progressive angina, 24% nocturnal angina, 53% smoked, 42% had a history of hypertension, 10% had diabetes, 13% had hyperlipidemia, 42% had ST-T wave changes on ECG, 33% had a history of MI, 11% had Q waves on ECG, 11% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 4% had peripheral vascular disease, 2% had cerebral vascular disease. It can therefore be seen that those having a cardiac catheterization were more likely to be male, smoke, have a history of MI, have ST-T wave changes on ECG and to be suffering typical or progressive angina At 3 years data for 973 patients (94%) was obtained. At the end of 3 years 844 patients were alive. 30 had died of cardiovascular causes, 19 had died of noncardiac causes, 18 had undergone angioplasty and 62 had had coronary artery bypass graft surgery.
Recruitment	Patients were referred for non-invasive testing for suspected coronary artery disease
Setting	Duke University Medical Centre USA
Interventions/ Test/ Factor being investigated	Physicians initial evaluation of patients with suspected CAD
Comparisons	The presence of significant coronary disease defined as any disease, severe disease, left main disease, predicting survival
Length of Study/ Follow-up	3 years
Outcome measures studied	Effectiveness of chest pain score to predict coronary artery disease and survival

Results	The three diagnostic outcomes were; the presence of significant coronary artery disease defined as 'any disease' (≥ 75% luminal diameter narrowing of at least one major coronary artery), presence of severe coronary artery disease defined as 'severe disease' (significant obstruction of all 3 main coronary arteries or the left main coronary artery) and the presence of significant left main artery obstruction defined as 'left main disease' (168 patients referred for cardiac catheterization). The prognostic outcome was survival at 3 years. In the multivariable regression model used, chest x-ray to show cardiomegaly was not a significant predictor for any disease, severe disease or left main disease. However for cardiomegaly (shown on chest x-ray) was a significant predictor for survival at 3 years.
Safety and adverse effects	None reported
Does the study answer the question?	In the multivariable regression model used, chest x-ray which showed cardiomegaly was shown to be a significant predictor of survival. However it could not be used to predict coronary disease.
Effect due to factor in study?	Yes
Consistency of results with other studies?	No other similar studies
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Question 8: In adults presenting with acute chest pain/discomfort of suspected cardiac origin, what is the clinical and cost effectiveness of giving oxygen compared with a placebo?

Grading: 1+	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias

Meme Wijesinghe;Kyle Perrin;Anil Ranchord;Mark Simmonds;Mark Weatherall;Richard Beasley;

The routine use of oxygen in the treatment of myocardial infarction: systematic review

Ref ID 24290 Heart pgs: 1 to 15 2008

Study Type Systematic Review

Funding No specific funding was sought for this study.

Number of participant Two RCTs

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

This review set out to assess the effectiveness of routine oxygen in the treatment of myocardial infarction (MI) in humans (most of the available evidence on the benefits of routine oxygen in MI come from animal studies). The primary outcome variable was in-hospital mortality. Only two studies met the inclusion criteria and only one included mortality as an outcome. The latter study included 200 patients with suspected MI (43 patients in whom MI was not subsequently confirmed were excluded from the analysis). There were 9/80 (11.3%) deaths in the oxygen group and 3/77(3.9%) in the air group, relative risk of death was 2.9 (95% CI 0.8 to 10.3, P=0.08).

The review concludes that there is little evidence by which to determine the efficacy and safety of high flow oxygen therapy in MI. The evidence that does exist suggests that routine oxygen may result in a greater infarct size and possibly increase the risk of mortality.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Nicholson C;

A systematic review of the effectiveness of oxygen in reducing acute myocardial ischaemia

Ref ID 71 Journal of Clinical Nursing pgs: 996 to 1007 2004

Study Type Systematic Review **Funding** not reported

Number of participant 9 Controlled clinical trials (2 randomised and 7 non randomised)

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

A systematic review (SR) on the effectiveness of oxygen in reducing acute myocardial ischaemia identified 9 studies; 2 randomised controlled trials (RCT(s)) and 7 case control studies (Nicholson 2004). The intervention was oxygen of any flow rate or delivery method (excluding hyperbaric oxygen). The studies identified had a combined total of 463 patients, of which 93 were women and 37 which had no gender stated. Of the 7 studies that reported age, the ranges and the means were comparable. Seven out of 9 studies reported haemodynamic data. The data synthesis of the SR found that oxygen administration resulted in; an unchanged heart rate but a fall in stroke volume and cardiac volume, a rise in systemic vascular resistance, and either a slight rise or no change in arterial blood pressure (Nicholson 2004).

Five of the 9 studies reported metabolic data. Lactate levels were measured in 2 studies; one found oxygen reduced lactate levels in the patients tested, while the second study found no change with oxygen. Two studies examined lactate extraction ratios, one showing oxygen had no effect and the other indicating that ratios were worse with oxygen administration. Another study found oxygen administration resulted in an increase in the cardiac enzyme aspartate aminotransferase (Nicholson 2004).

Electrocardiogram data were reported in 3 of the 9 studies. Two examined ST-depression, one study found that oxygen did not prevent the onset of ischaemic changes, and the other found oxygen administration was not associated with any changes to the ST-segment. The third study used a 49-lead precordial electrocardiogram mapping technique and noted occurrences of ST-elevation and the sum of all ST-segment elevation. ST-elevation is usually ascribed to injury-infarction and this study may not have measured the same effect as the other studies

using electrocardiogram data. This third study found oxygen administration reduced both the number of elevated ST-segments and the sum of all the elevation (Nicholson 2004).
None of the studies reported any respiratory side effects, and only one study reported any side effect which was nausea as a reason for withdrawal from oxygen administration (Nicholson 2004).
The author of the SR concluded that there was a lack of strong evidence for using oxygen as a treatment of acute myocardial infarction (MI), although it was recognised that all patients with systemic hypoxaemia should have this corrected by oxygen administration (Nicholson 2004).

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Rawles JM;Kenmure AC;

Controlled trial of oxygen in uncomplicated myocardial infarction

Ref ID 2303 Br Med J pgs: 1121 to 1123 1976

Study Type Randomised Controlled Trial **Funding** Not reported

Number of participant 200 patients were included; 105 were randomised to receive oxygen, 95 to receive air

Inclusion/Exclusion Criteria Patients were under 65 who were admitted to the coronary care unit where the admitting medical officer suspected the patient to have had a MI in the previous 24 hours. Patients were excluded if they had clinical evidence of right or left heart failure, chronic bronchitis or emphysema or breathlessness from any other cause or if the has been transferred from other wards for treatment of arrhythmias or had undergone a cardiac arrest before admission or had suffered from cardiogenic shock

Patient Characteristics

Those without confirmation of an MI:
Air group –
Number of patients 18
Number of men 17
Mean age 50.8 ± 2.4

Oxygen group –
Number of patients 25
Number of men 19
Mean age 51.3 ± 1.7

Those with a confirmed MI:
Air group –
Number of patients 77
Number of men 61
Mean age 56.4 ± 0.8

Oxygen group –
Number of patients 80
Number of men 63
Mean age 55.1 ± 0.9

Recruitment Patients admitted to the coronary care unit at Aberdeen Royal Infirmary which met the inclusion criteria

Setting Hospital - Coronary Care Unit

Interventions/ Test/ Factor being investigated

Oxygen or compressed air as given through an MC mask at a flow rate of 6 L/min for 24 hours.

Comparisons

The comparison is between receiving oxygen and air

Length of Study/ Follow-up

Patients were followed up for 24 hours

Outcome measures studied

In all patients: ECG, serum aspartate aminotransferase level, Pao2, stay in hospital, number of patients given diamorphine and the number of doses. Patients with confirmed MI: arrhythmias, heart rate and PEP/LVET

Results

Those without confirmation of an MI:

	Air group	Oxygen group	
Number of patients	18	25	
Mean Pao2 (kPa)	11.2 ± 0.17	23.7 ± 1.32	(1kPa = 7.5Hg)
Mean stay in hospital (d)	9.9 ± 1.6	11.1 ± 1.3	
No. Pts given diamorphine	3	11	
Mean no. doses of diamorphine	2.7 ± 0.9	1.4 ± 0.2	
Mean serum aspartate aminotransferase Level (IU/ml)	18.3 ± 3.0	15.8 ± 1.1	

Those with a confirmed MI:

	Air group	Oxygen group	
Number of patients	77	80	
Mean Pao2 (kPa)	8.7 ± 0.29	18.2 ± 1.56	(1kPa = 7.5Hg)
Mean stay in hospital (d)	14.9 ± 0.6	16.2 ± 0.6	
No. Pts given diamorphine	52	57	
Mean no. doses of diamorphine	2.0 ± 0.2	2.1 ± 0.2	
Mean serum aspartate aminotransferase Level (IU/ml)	80.7 ± 6.6	99.9 ± 7.1	
Mean heart rate/min	72.7 ± 1.7	77.0 ± 1.7	
Mean PEP/LVET day 1	0.43 ± 0.04	0.35 ± 0.03	
day 2	0.44 ± 0.06	0.37 ± 0.02	

Number of patients with arrhythmias after MI

	Air group	Oxygen group
Atrial ectopics	35	34
Mean frequency/min (when present)	0.44 ± 0.22	0.45 ± 0.16
Atrial tachycardia	2	6
Atrial flutter	2	0
Atrial fibrillation	4	4
Sinus tachycardia	11	23
Sinus bradycardia	36	26
Junctional rhythm	5	2
Accelerated idioventricular rhythm	9	7
Ventricular ectopics	62	72
Mean frequency/min (when present)	0.57 ± 0.12	0.42 ± 0.08
Ventricular tachycardia	5	11
Ventricular fibrillation	1	1
Heart block 1o	6	2
2o	4	1
3o	1	1

Safety and adverse effects

Those who received oxygen had an increase in sinus tachycardia, Pao2, serum aspartate aminotransferase. There were 12 deaths in total, 9 in the oxygen group and 3 in the air group. 3 of the deaths occurred during treatment 1 was receiving oxygen and 2 were receiving air

Does the study answer the question?

The paper does start to address the key clinical question; it highlights several effects giving oxygen has to patients. The paper shows there is a significant increase in the sinus tachycardia for those who received oxygen compared to those who received air. The paper also showed that the serum aspartate aminotransferase level is significantly higher in the oxygen group than the air group. The paper shows that giving oxygen does not reduce to number arrhythmias, nor does it affect the number of mortalities or give rise to an improvement in left ventricular function.

	The paper suggests that giving oxygen may be harmful and does not appear to give a beneficial effect. It suggests that oxygen should not be given routinely but instead should be given to those with obvious hypoxia.
Effect due to factor in study?	Patients were also able to receive diamorphine, which could have affect results, however it is likely that the intervention of oxygen was most likely to have caused the results of the study
Consistency of results with other studies?	No other comparable studies
Directly applicable to guideline population?	Correct intervention and population
Internal Validity	Patients changed to oxygen were included in result

Wilson AT;Channer KS;

Hypoxaemia and supplemental oxygen therapy in the first 24 hours after myocardial infarction: the role of pulse oximetry

Ref ID 1796 J R Coll Physicians Lond pgs: 657 to 661 1997

Study Type Randomised Controlled Trial **Funding** Unknown

Number of participant	22 in group 1 receiving continuous oxygen post MI at 4 litres per minute by face mask; 20 in group 2 receiving no supplemental oxygen except for central cyanosis or respiratory distress.
Inclusion/Exclusion Criteria	50 consecutive patients with acute MI admitted to the coronary care unit at the Royal Hallamshire Hospital participate within six hours of the onset of thrombolytic therapy. Patients with central cyanosis, pulmonary disease requiring oxygen independent of the cardiac status or those in whom blood gas estimation showed a pCO-2 > 5.5 kPa and patients with left ventricular failure requiring inotrope support were excluded.
Patient Characteristics	There were 25 men and 17 women in the study. The two groups were comparable for the number of smokers (5 and 7 respectively), diabetics (2 and 2) and mean ages (64 and 65 years).
Recruitment	The subjects were consecutive patients with acute MI admitted to the coronary care unit at the Royal Hallamshire Hospital
Setting	Royal Hallamshire Hospital, England
Interventions/ Test/ Factor being investigated	The incidence and degree of hypoxaemia in patients with acute MI was studied to assess the use of pulse oximetry and supplemental oxygen therapy in the first 24 hours after MI
Comparisons	A comparison is made between the use of continuous oxygen at 4 litres pre minute and no oxygen therapy. All subjects were monitored with pulse oximetry through the first 24 hours post MI.
Length of Study/ Follow-up	24 hours
Outcome measures studied	Oxygen saturation (SpO-2) and arrhythmias and ST segment changes were measured
Results	Twenty of the 42 (48%) patients had periods of at least moderate hypoxaemia (SpO-2 <90%) and 8 (19%) patients had severe hypoxaemia(SpO-2 <80%). Seven of the 8 severely hypoxaemic patients were in group 2 ($p<0.05$) which received no supplemental oxygen and were clinically undetected in all but one case (pO-2 71%). There were no significant differences in the prescription of opiates between groups. There were no significant differences between groups in the incidence or type of arrhythmias (11 in each group) or ST segment changes (3 and 4 respectively). The postal survey revealed the following: 105 units (51%) did not use routine oxygen yet 81 (77%) of these had a pulse oximeter. Only

	3% said they measured oxygen saturation in all patients although 14% said they measured if blood gases were poor. In 93 units (45%) oxygen therapy was routinely given and pulse oximetry was available in 76 (80%) of these. However, oxygen saturation was routinely measured in only 6% and measured in 8% when indicated by poor arterial blood gases.
Safety and adverse effects	None reported
Does the study answer the question?	This study demonstrates that hypoxaemia in the first 24 hours after an acute MI is a frequent and predictable occurrence and that this remains undetected by the medical and nursing staff unless a pulse oximeter is used.
Effect due to factor in study?	This study demonstrated no statistical correlation between hypoxaemic events and adverse cardiac events but the study was too small to assess this outcome effectively. Otherwise, the results of pulse oximetry appear to be accurate.
Consistency of results with other studies?	With regard to adverse cardiac events there is a lack of consistency.
Directly applicable to guideline population?	Yes
Internal Validity	No control arm and no allocation concealment

Question 9: In adults presenting with chest pain, what is the clinical and cost effectiveness of pain management (e.g. sublingual and buccal nitrates, diamorphine, morphine with anti-emetic) compared with active comparators?

Grading: 1+	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias

Hayes MJ;Fraser AR;Hampton JR;

Randomised trial comparing buprenorphine and diamorphine for chest pain in suspected myocardial infarction

Ref ID 3472 Br Med J pgs: 300 to 302 1979

Study Type Randomised Controlled Trial **Funding** Not reported

Number of participant	study 1: 10 patients, study 2: 43 patients, study 3: 118 patients
Inclusion/Exclusion Criteria	inclusion: patients with chest pain due to suspected MI who required analgesia
Patient Characteristics	study 3: Buprenorphine group - male:female ratio = 5.6:1, mean age 55 ± 10 years, mean duration of chest pain 5.5 ± 7.3 hours, previous analgesia (morphine, diamorphine or pethidine) 54%, admission heart rate 78 ± 19 beats per min, systolic blood pressure 129 ± 28 mm Hg, diastolic blood pressure 82 ± 22 mm Hg, mean AST 136 ± 154 IU/l, mean SHBD 567 ± 352 IU/l, ECG changes - anterior infarction 44%, other sites of infarction 36%, no changes of infarction 20% Diamorphine group - male:female ratio = 3.5:1, mean age 56 ± 10 years, mean duration of chest pain 7.9 ± 11.6 hours, previous analgesia (morphine, diamorphine or pethidine) 54%, admission heart rate 80 ± 23 beats per min, systolic blood pressure 127 ± 31 mm Hg, diastolic blood pressure 79 ± 24 mm Hg, mean AST 97 ± 68 IU/l, mean SHBD 544 ± 375 IU/l, ECG changes - anterior infarction 41%, other sites of infarction 34%, no changes of infarction 25%
Recruitment	patients admitted to the CCU with chest pain due to suspected MI
Setting	Secondary care, England
Interventions/ Test/ Factor being investigated	intravenous buprenorphine, sublingual buprenorphine, diamorphine
Comparisons	intravenous buprenorphine, sublingual buprenorphine, diamorphine
Length of Study/ Follow-up	48 hours
Outcome measures studied	pain relief, need for further analgesia, systolic blood pressure, heart rate
Results	The paper carried out 3 studies Study 1 Haemodynamic studies were performed on an initial 10 patients with MI proved on ECG. All had received diamorphine previously but then required further analgesia for recurrent pain. The pulmonary artery pressure was recorded continuously before and after an intravenous injection of 0.3 mg buprenorphine, by means of a 3 F gauge polyethylene catheter inserted percutaneously via an antecubital vein. Cuff measurements of the systemic blood pressure were made at defined intervals. The ECG was monitored continuously and measurements of heart rate obtained from the ECG. This study showed that intravenous buprenorphine had no significant effect on heart rate or systemic diastolic blood pressure. There was a sustained fall in systemic arterial systolic pressure of about 10 mmHg but this was not statistically significant. Study 2

43 patients who required analgesia in the coronary care unit were given either injections of intravenous buprenorphine or sublingual tablets. 18 received a total of 20 tablets of sublingual buprenorphine 0.4 mg, and 25 received a total of 40 injections of intravenous buprenorphine 0.3 mg as and when they needed analgesia for chest pain. In this group only systemic blood pressure and heart rate were measured and the ECGs were continuously monitored. The degree of pain relief and more particularly the time of onset of pain relief were assessed subjectively by the medical and nursing staff.

In the intravenous buprenorphine group 9 patients had complete relief after 5 minutes, a further 21 patients had complete relief after 15 minutes, a further 3 patients had complete relief after 30 minutes and 6 further patients had complete relief after 45 minutes. 1 patient reported inadequate pain relief. In the sublingual buprenorphine group 2 patients had complete relief after 5 minutes, a further 2 patients had complete relief after 15 minutes, a further 12 patients had complete relief after 30 minutes and 3 further patients had complete relief after 45 minutes. 1 patient reported inadequate pain relief.

The study showed that sublingual buprenorphine had no significant effect on systolic blood pressure and heart rate and provided good pain relief to most patients. Intravenous buprenorphine gave faster pain relief.

Study 3
120 patients who were admitted to the CCU with chest pain due to suspected myocardial infarction and who required analgesia were randomly allocated in a double-blind fashion to receive either buprenorphine 0 3 mg intravenously or diamorphine 5 mg intravenously. There were no medical contraindications for inclusion in this trial. Patients were randomised in blocks of six, the trial ampoules being prepared and issued by the General Hospital pharmacy daily because of the instability of diamorphine when in solution. After entry into the trial records were kept of the time, dose, and frequency of subsequent analgesic administration. The time, degree, and duration of pain relief were monitored using an unmarked visual analogue scale, 3 which was scored by the patient. The scale was subsequently measured and pain relief expressed as a percentage of the original score. If the patients were asleep they were left undisturbed and considered to have complete pain relief. The incidence of nausea, vomiting, and other adverse reactions was also recorded.

In the buprenorphine group 27 (49%) patients did not require further analgesia after initial dose, 12 (22%) required analgesia within 6 hours after initial dose and 16 (29%) required analgesia in 6-48 hours after initial dose.
In the diamorphine group 23 (42%) patients did not require further analgesia after initial dose, 16 (29%) required analgesia within 6 hours after initial dose and 16 (29%) required analgesia in 6-48 hours after initial dose.

Safety and adverse effects

None reported

Does the study answer the question?

This study showed that sublingual buprenorphine had no significant effect on systolic blood pressure and heart rate and provided good pain relief to most patients. However the concluded that intravenous buprenorphine gave faster pain relief. The difference in the visual pain relief during the 6 hour trial was not statistically significant between the buprenorphine and diamorphine groups. The analgesic requirements for the two groups were not significantly different either. At five minutes the percentage pain relief in the buprenorphine group was significantly less than in the diamorphine group ($p<0.01$), but this difference progressively diminished so that both groups were similar at 15 minutes, there was no difference in the two groups at 6 hours.

Overall the study showed that there was no statistically significant difference in the requirement of subsequent analgesia or in the percentage pain relief.

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?	Patients had chest pain due to suspected MI and required analgesia
Internal Validity	No report of concealment methods

Hew E;Haq A;Strauss H;

A randomized controlled trial of nalbuphine vs morphine in the treatment of ischemic chest pain

Ref ID 3362 | Current Therapeutic Research - Clinical and Experimental | pgs: 394 to 402 | 1987

Study Type Randomised Controlled Trial **Funding** not reported

Number of participant	24 patients received nalbuphine, 29 received morphine
Inclusion/Exclusion Criteria	inclusion: moderately severe to severe pain unresponsive to sublingual nitroglycerin and a suspected diagnosis of MI or unstable angina. Exclusion: heart rate less than 50 beats per minute, systolic blood pressure less than 90 mmHg, cardiac shock, acute or chronic renal failure, valvular heart disease, signs of right or left ventricular failure, pulmonary oedema, patient is a or suspected of being a drug user
Patient Characteristics	In the nalbuphine group 3 were female, mean age was 60 years old. The mean pain was 5.5 ± 0.5, the mean systolic blood pressure was 134.5 ± 4.4 mmHg, diastolic blood pressure was 82.2 ± 2.8, the mean respiratory rate was 19.7 ± 0.6 breaths/min, the mean heart rate was 71.3 ± 3.9 beats/min. the concomitant of treatments were 7 patients had nitroglycerin infusion, 1 patient had antiarrhythmic, 1 patient had beta-blocker, 2 patients had calcium-channel blocker. In the morphine group 9 were women, mean age 62.2 years old. The mean pain was 6.3 ± 0.4, the mean systolic blood pressure was 142.6 ± 5.3 mmHg, diastolic blood pressure was 80.1 ± 2.6, the mean respiratory rate was 20.7 ± 0.7 breaths/min, the mean heart rate was 74.1 ± 3.2 beats/min. the concomitant of treatments were 7 patients had nitroglycerin infusion, 2 patients had antiarrhythmic, 0 patients had beta-blocker, 0 patients had calcium-channel blocker.
Recruitment	patients with ischemic chest pain admitted to 2 hospitals in Canada
Setting	Secondary care (2 hospitals), Canada
Interventions/ Test/ Factor being investigated	10 mg morphine or 20mg nalbuphine
Comparisons	10 mg morphine or 20mg nalbuphine
Length of Study/ Follow-up	2 hours
Outcome measures studied	pain relief
Results	Complete pain relief: At 5 minutes – 21% on morphine, 42% on nalbuphine At 15 minutes – 31% on morphine, 54% on nalbuphine At 30 minutes – 34% on morphine, 54% on nalbuphine At 60 minutes – 48% on morphine, 58% on nalbuphine At 120 minutes – 55% on morphine, 67% on nalbuphine The mean pain scores for nalbuphine group were consistently lower than for the morphine group. The difference in scores was greatest after 5 minutes (nalbuphine = 1.88, morphine = 3.48), however the difference was not significant (F = 3.07, P = 0.08). The mean pain relief scores and the sum of the pain relief scores consistently favoured nalbuphine with the greatest difference at 5 minutes but were not significantly different (F = 2.83, P = 0.10). Neither group had a significant change in either systolic or diastolic blood pressure (F = 1.45, P >0.21). The mean heart rate did not change significantly for either group (F = 1.82, P = 0.11).

Safety and adverse effects	There were 81 unpleasant or unusual side effects reported. In the morphine group 62% reported at least 1 side effect, compared to 75% in the nalbuphine group. The mean number of complaints in the morphine group was 1.5 and in the nalbuphine group was 1.6. there was no statistically significant difference in the incidence of any complaint, including drowsiness and dry mouth which was observed. Adverse events: (number of patients) Drowsiness – 4 on morphine, 9 on nalbuphine Dizziness – 8 on morphine, 4 on nalbuphine Nausea – 5 on morphine, 6 on nalbuphine Dry mouth – 6 on morphine, 1 on nalbuphine Headache – 6 on morphine, 1 on nalbuphine Diaphoresis – 2 on morphine, 2 on nalbuphine Nervousness – 2 on morphine, 1 on nalbuphine Hypotension – 1 on morphine, 2 on nalbuphine Burning at injection site – 2 on morphine, 1 on nalbuphine Vomiting – 1 on morphine, 1 on nalbuphine Euphoria – 0 on morphine, 2 on nalbuphine Depressed – 1 on morphine, 1 on nalbuphine Urticaria – 1 on morphine, 1 on nalbuphine Bradycardia – 0 on morphine, 2 on nalbuphine Other – 4 on morphine, 4 on nalbuphine
Does the study answer the question?	None of the differences were statistically significant, the trend favoured nalbuphine. The greatest difference was seen at 5 minutes. The author states the ideal analgesic should provide prompt relief from pain and anxiety without adversely affecting hemodynamic or respiratory function, this study suggests that nalbuphine fulfils this and should be considered as an alternative to morphine.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients had moderately severe to severe pain due to suspected MI or unstable angina and unresponsive to sublingual nitroglycerin

Internal Validity

Jamidar HA CSAA;

Nalbuphine versus diamorphine early in the course of suspected myocardial infarction

Ref ID 4222 Eur Heart J pgs: 597 to 602 1987

Study Type Randomised Controlled Trial **Funding** Dr J Beets and Dupont supplied the Nalbuphine

Number of participant	176 in total; 87 received Nalbuphine, 89 received Diamorphine
Inclusion/Exclusion Criteria	Inclusion: patients with moderate or severe pain of suspected AMI who have not received previous analgesia
Patient Characteristics	In the Nalbuphine group: The mean age was 60.5 years, 41 % were women. 43% smoked, 30% were ex-smokers. 2% had diabetes, 21% had previous hypertension. 13% had previous severe angina, 29% had previous moderate angina, 20% had previous mild angina. 8% had more than 2 previous MIs,14% had 2 previous MIs, 29% had 1 previous MI, 49% had had no previous MI. In the Diamorphine group: The mean age was 62.2 years, 34 % were women. 35% smoked, 25% were ex-smokers. 9% had diabetes, 25% had previous hypertension. 18% had previous severe angina, 10% had previous moderate angina, 29% had previous mild angina. 8% had more than 2 previous MIs, 6% had 2 previous MIs, 26% had 1 previous MI, 60% had had no previous MI. NOTE one person died before a full history could be taken (smoking and previous MI data missing)

Recruitment	Patients admitted with moderate or severe chest pain of a suspected acute MI
Setting	Royal Victoria Hospital, Belfast, Northern Ireland
Interventions/ Test/ Factor being investigated	≤ 20 mg nalbuphine or ≤ 5 mg diamorphine intravenously with 10 mg metoclopramide
Comparisons	between ≤ 20 mg nalbuphine or ≤ 5 mg diamorphine intravenously with 10 mg metoclopramide
Length of Study/ Follow-up	2 hours
Outcome measures studied	pain relief at set times
Results	The differences in baseline characteristics were not statistically significant (P=>0.05). Pain was recorded at 10 minutes, 30 minutes, 60 minutes and 120 minutes. At 10 minutes 77% of the nalbuphine group and 68% of the diamorphine group had satisfactory pain relief; 44% of the nalbuphine group and 39% of the diamorphine group had complete pain relief. Satisfactory pain relief (grade 0 or 1 pain) was similar for both groups during each time assessment. So there was no significant difference between the two groups for total pain relief. The average pain score at each time interval was similar for both groups. The number of doses of each drug given over the 120 minutes were comparable (n 114 + SD 0-4, d 1-28±SD 0-5). Of those withdrawn from the trial (two doses of the test drug without satisfactory pain relief) 6 patients had received diamorphine and 11 nalbuphine. This difference was not statistically significant. Pain recurred after satisfactory pain relief in 2 patients who had received diamorphine and in 5 who had received nalbuphine. There were no significant differences for heart rate, systolic and diastolic blood pressures between the two groups throughout the 120 minute observation period. Only one patient in the nalbuphine group and 3 in the diamorphine group required atropine and only 2 in the nalbuphine group and 2 in the diamorphine group received beta-blockers intravenously during the trial period. The numbers with cardiac failure initially and at 120 minutes showed no significant differences for the two groups. There were no significant differences between the two groups for mean peak CK, AST and LDH. Seven patients received streptokinase and their enzyme levels were excluded from analysis.
Safety and adverse effects	dizziness, nausea and vomiting was infrequent but occurred in both groups In the Nalbuphine group: 16% had dizziness, 14% had nausea and vomiting, 10% had other side effects, 1% died (1 patient) In the Diamorphine group: 17% had dizziness, 16% had nausea and vomiting, 7% had other side effects, 8% died (7 patients)
Does the study answer the question?	The results for pain relief for the nalbuphine group and the diamorphine group were similar with no statistically significant difference. The study showed that Nalbuphine is safe and is as effective as diamorphine, with the speed of pain relief and reoccurrence of pain being similar for both groups. Nalbuphine had no adverse events on infarct size nor deleterious heamodynamic side effects.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	The population was patients with moderate or severe chest pain of suspected MI
Internal Validity	patients were withdrawn for further pain relief

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Everts B;Karlson BW;Herlitz J;Hedner T;

Morphine use and pharmacokinetics in patients with chest pain due to suspected or definite acute myocardial infarction

Ref ID 2966 European Journal of Pain pgs: 115 to 125 1998

Study Type Cohort

Funding Swedish Medical Research Council and Medical Faculty, University of Goteborg and Bohuslandstinget

Number of participant	2988
Inclusion/Exclusion Criteria	Patients had chest pain or symptoms suggestive of AMI, Patients had to have a confirmed or suspected AMI or myocardial ischaemia and were hospitalised and stayed for more than 1 day.
Patient Characteristics	The mean age was 69.3 ± 0.23 years (range 18-101 years), 40.2% were women. 921 patients developed an MI, 357 had a possible MI, 419 had myocardial ischaemia, 1291 had possible myocardial ischaemia
Recruitment	patients with chest pain or symptoms suggestive of AMI admitted to CCU in Sweden
Setting	Secondary care, Sweden
Interventions/ Test/ Factor being investigated	10mg morphine hydrochloride intravenously over one minute
Comparisons	pain relief after being given 10mg morphine hydrochloride intravenously over one minute
Length of Study/ Follow-up	3 days
Outcome measures studied	pain, morphine requirement
Results	The average pain intensity was 6.6±0.6 on the Numerical Rating Scale (NRS) before the morphine injection. There was rapid pain relief (6.9±11% after 20 minutes) after the morphine injection. After 20 minutes, a nadir was obtained where NRS ranged between 0 and 3 units. 7 out of 10 patients reported being pain free at one or more measurement point during the first 3 hours following morphine injection. However 3 patients needed supplementary analgesic treatment with meperidine and 1 patient was given metoprolol. 5 patients required diuretics but no patients were given thrombolysis or nitrates. The patient characteristics which were associated with higher morphine requirements were: gender (female) P = <0.0455, history of angina pectoris P = <0.0001, previous CHF P = <0.0001, initial degree of suspicion of AMI P = <0.0001, presence of ST elevation on entry ECG P = <0.0001, presence of ST depression on entry ECG P = <0.0004, Q wave on entry ECG P = <0.0015. The mean systolic/diastolic blood pressure at arrival at the CCU was 143±9.9/91±4.6mm Hg. After intravenous morphine administration there was a significant reduction in the diastolic blood pressure but a similar but non-significant trend in systolic blood pressure. Heart rate was 86±5.1 beats/minute on admission and tended to be reduced during the observation period after intravenous morphine. Respiratory frequency remained unchanged in all patients.

Safety and adverse effects	None reported
Does the study answer the question?	The study showed that there was rapid pain relief 20 minutes after the morphine injection with 7 out of 10 patients reporting complete pain relief at 1 or more measurement points during the 3 hours observation. There were certain patient characteristics associated with higher morphine requirement: gender (female), history of angina pectoris, previous CHF, initial degree of suspicion of AMI, presence of ST elevation on entry ECG, presence of ST depression on entry ECG, Q wave on entry ECG. The authors concluded that when intravenous morphine is given it has full effect after 20 minutes. The authors also concluded that the need for morphine administration in patients with confirmed or suspected AMI differed among subgroups, in particular those with a strongly suspected AMI required higher doses of morphine.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Pains had chest pain or symptoms suggestive of AMI
Internal Validity	Well covered

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Bruns BM;Dieckmann R;Shagoury C;Dingerson A;Swartzell C;

Safety of pre-hospital therapy with morphine sulfate

Ref ID 844 The American journal of emergency medicine, pgs: to 1992

Study Type	Cohort	**Funding**	Not reported

Number of participant	84 patients
Inclusion/Exclusion Criteria	patients who received morphine sulphate in a prehospital setting
Patient Characteristics	the mean age was 68 years, 40 patients were male 39 were female and 5 patients did not have their sex documented
Recruitment	patients who the paramedics assessed as having ischaemic chest pain or pulmonary edema, which was agreed by a doctor at the base hospital were given intravenous morphine sulphate in 2mg increments along with other therapies according to treatment protocol
Setting	Paramedics, San Francisco, USA
Interventions/ Test/ Factor being investigated	safety of prehospital morphine sulphate use in an urban emergency medical system
Comparisons	The diagnosis by a paramedic and an emergency department doctor
Length of Study/ Follow-up	6 months
Outcome measures studied	1: Accuracy of paramedics diagnosis 2: Appropriate use of morphine sulphate 3: Side effects of appropriate and inappropriate use of morphine sulphate
Results	All patients who received morphine sulphate were included in the study. Patients who the paramedics assessed as having ischaemic chest pain or pulmonary oedema, paramedics phone through to the base hospital, where a mobile intensive care nurse and/or a doctor concurred the diagnosis. The paramedic then gave the patient intravenous morphine sulphate in 2mg increments along with other therapies according to treatment protocols. 3 private and 1 public paramedic provider agencies were included which took patients to 10 emergency departments. A total of 84 patients were given morphine sulphate. The paramedics' diagnosis was considered accurate in 77% of cases (65 out of 84) Paramedics diagnosed 40 patients with ischaemic chest pain, when patients were diagnosed in the emergency department - 30 had ischaemic chest pain, 4 had ischaemic chest pain and pulmonary oedema, 1 had a pulmonary oedema and 5 had another diagnosis. Paramedics diagnosed 31 patients with pulmonary oedema, when patients were diagnosed in the emergency department - 23 had pulmonary oedema, 4 had ischaemic chest pain and pulmonary oedema and 4 had another diagnosis. Paramedics diagnosed 13 patients with ischaemic chest pain and pulmonary oedema, when patients were diagnosed in the emergency department – 3 had ischaemic chest pain and pulmonary oedema, 9 had a pulmonary oedema and 1 had another diagnosis. (Other diagnosis included atypical chest pain, atypical chest pain and chronic heart failure, acute bronchospasm and pneumonia) In the 9 cases where the paramedics miss diagnosed ischaemic chest pain or pulmonary oedema 5 patients were diagnosed as ischaemic chest pain but missed a

diagnosis of pulmonary oedema and 4 patients were diagnosed as pulmonary oedema but missed a diagnosis of ischaemic chest pain

The appropriateness of morphine sulphate administration was assessed the 9 diagnosis which missed either ischaemic chest pain or pulmonary oedema were still treated correctly with morphine sulphate. The appropriateness use of morphine sulphate was 88%.

The overall side effects rate was 6%, 3 patients had respiratory depression and 2 had hypotension. 2 of the patients who had respiratory depression were correctly diagnosed with pulmonary oedema, which can lead to respiratory depression; therefore it is unclear if the morphine sulphate caused the side effect. The other patient who had respiratory depression was diagnosed wrongly by the paramedic and had an emergency department diagnosis of pneumonia, therefore it is likely the morphine sulphate caused the respiratory depression. The 2 patients who had hypotension were both correctly diagnosed by the paramedic and it is uncertain if the morphine sulphate caused the hypotension.This shows that only 1 patient suffered an adverse event due to inappropriate use of morphine sulphate, the complication rate for this was 10%.

Safety and adverse effects

3 cases of respiratory depression, 2 cases of hypotension

Does the study answer the question?

The study showed that the paramedics' diagnosis was considered accurate in 77% of cases (65 out of 84). The appropriateness use of morphine sulphate was 88, and the overall side effects rate was 6%, the complication rate for inappropriate use of morphine sulphate was 10%.
The authors concluded that paramedics functioning with a system of base hospital direction can safely given morphine sulphate, with the inappropriate administration of morphine sulphate and complication rate being low.

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

This was a mixed population including some patients with pulmonary oedema

Internal Validity

Well covered

Herlitz J;Richterova A;Bondestam E;Hjalmarson A;Holmberg S;Hovgren C;

Chest pain in acute myocardial infarction: a descriptive study according to subjective assessment and morphine requirement

Ref ID 1168 Clin Cardiol pgs: 423 to 428 1986

Study Type Cohort

Funding Swedish Medical Research Council, the Swedish National Association against Heart and Chest Disease, the Goteborg Medical Society, AB Hassle subsidiary of Astra Pharmaceuticals

Number of participant

653 patients

Inclusion/Exclusion Criteria

Patients admitted to the CCU with suspected acute MI admitted between 1st May 1983 and 31st May 1984

Patient Characteristics

The age range was 33-92 years with the median being 70 years. 38.3% were women, 47.1% were aged over 70 years, 39.2% had had a previous infarction, 59.4% had angina pectoris, 36.2% had hypertension, 21.2% had congestive heart failure. 24.5% had furosemide before admission, 38.6% had beta blockers before admission,

	10.2% had Ca antagonists before admission
Recruitment	Patients who were admitted to the CCU with suspected AMI were evaluated for inclusion
Setting	Patients home and hospital
Interventions/ Test/ Factor being investigated	Patients pain and analgesic requirement
Comparisons	Pain at home and in hospital
Length of Study/ Follow-up	3 days
Outcome measures studied	visual pain score, narcotic analgesic requirement
Results	The study recorded patient's pain by a visual scale of 0-10 as reported by the patients (0 being no pain and 10 being worst pain imaginable). The pain scores recorded were the maximum pain at home (recorded once admitted to CCU) and every two hours for 6 hours after admission to CCU. If patients were asleep at the time of recording a score of 0 was reported. Patients were given morphine intravenously for severe pain and nitroglycerine sublingually for less severe pain interpreted as angina pectoris; where patients were given analgesics the pain score was increase by 2. MI was confirmed in 45% of patients and possible MI in 11.9%. Mean maximum score at home Patients with defined MI: 7.5 Patients with possible MI: 6.6 Patients with ischemia: 6.9 Patients with no ischemia: 5.9 Mean pain score during the first 6 hours (h) after arrival at CCU Patients with defined MI: on arrival 2.3, after 2h 1.4, after 4h 1.1, after 6h 0.9 Patients with possible MI: on arrival 1.2, after 2h 0.7, after 4h 0.6, after 6h 0.4 Patients with ischemia: on arrival 1.4, after 2h 0.8, after 4h 0.6, after 6h 0.7 Patients with no ischemia: on arrival 1.6, after 2h 0.9, after 4h 0.6, after 6h 0.7 See narrative for question 17; table 1: Herlitz et al, 1986 and figure 1: Herlitz et al, 1986
Safety and adverse effects	None reported
Does the study answer the question?	The study showed that for pain at home there were small differences in the mean pain scores between the groups of patients. For those with an MI the maximum pain score was 7.5±0.2 where as for those without an MI the maximum pain score was 6.6±0.2 ($P<0.001$). The study showed that for pain in the CCU the maximum mean score had reduced to 1.8 for all patients compared to 7.0 maximum mean score for all patients at home. The study also showed that 98% of patients had chest pain at home, but only 51% had pain on arrival at the CCU. Figure 1 (see narrative for question 17; figure 1: Herlitz et al, 1986) shows the course of pain after arrival at the CCU The authors commented that narcotic analgesics were given to 10% of patients after the end of recording pain scores and during the 3 day study 27.4% of patients were given nitroglycerine sublingually. The authors of the study concluded that patients generally had worse pain at home than in the CCU. The mean pain score values show a trend of rapid decline in pain after arrival in the CCU, although there was variability in the intensity and duration of chest pain. The authors commented that there was a low difference in the pain scores between those having an MI and those who were not.
Effect due to factor in study?	Yes

Consistency of results with other studies?	No other studies compare at home to hospital pain management
Directly applicable to guideline population?	Patients had suspected MI
Internal Validity	Well covered

Scott ME;Orr R;

Effects of diamorphine, methadone, morphine, and pentazocine in patients with suspected acute myocardial infarction

Ref ID 10272 Lancet pgs: 1065 to 1067 1969

Study Type Cohort **Funding** Not reported

Number of participant	118 patients; 30 in diamorphine group, 31 in methadone group, 29 in morphine group and 25 in pentazocine group
Inclusion/Exclusion Criteria	Included: patients initially assessed to have moderate or severe pain due to suspected acute MI. Excluded: patients who had cardiac shock, cardiac failure, severe nausea, pronounced bradycardia, who have received a potent analgesic or an anti-emetic in previous 4 hours
Patient Characteristics	25% were women, the age range was 30-79 years old, with 79% of patients aged between 50-69 years old. 36% of the patients had acute myocardial ischaemia rather than definite infarction. There was no significant difference in the sex-distribution, age, previous history of MI among the 4 treatment groups.
Recruitment	Patients who were admitted to the cardiac department, Royal Victoria Hospital, Belfast, Northern Ireland, who were initially assessed to have moderate or severe pain due to suspected acute MI
Setting	Secondary care, Northern Ireland
Interventions/ Test/ Factor being investigated	pain relief from analgesics
Comparisons	5 mg diamorphine or 10 mg methadone, 10 mg morphine, 30 mg pentazocine
Length of Study/ Follow-up	2 hours
Outcome measures studied	Pain relief at 10, 30, 60 and 120 minutes
Results	For some degree of pain relief: At 10 minutes - 90% of patients on diamorphine, 90% on methadone, 93% on morphine, 85% on pentazocine. At 30 minutes - 87% of patients on diamorphine, 94% on methadone, 93% on morphine, 96% on pentazocine. At 60 minutes - 87% of patients on diamorphine, 89% on methadone, 90% on morphine, 82% on pentazocine. At 120 minutes - 90% of patients on diamorphine, 86% on methadone, 86% on morphine, 81% on pentazocine. For complete of pain relief: At 10 minutes - 47% of patients on diamorphine,32% on methadone, 17% on morphine, 19% on pentazocine. At 30 minutes - 43% of patients on diamorphine, 39% on methadone, 38% on morphine, 36% on pentazocine. At 60 minutes - 43% of patients on diamorphine, 50% on methadone, 45% on morphine, 27% on pentazocine. At 120 minutes - 34% of patients on diamorphine, 50% on methadone, 52% on morphine, 33% on pentazocine.

Safety and adverse effects	Nausea and vomiting was similar across all groups (not statistically different). Morphine had an unexpected low number of patients with emetic sequelae
Does the study answer the question?	The results show equal pain relief by all 4 drugs. Diamorphine gave complete pain relief in 10 minutes to a higher number of patients, it was significantly higher compare to morphine and petazocine but not significantly higher compared to methadone. At 30 minutes the pain relief is similar across all 4 drugs, however at 60 minutes patients on pentazocine had lower pain relief than the other 3 groups The authors suggest that diamorphine is the drug of choice.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients had moderate or severe pain due to suspected acute MI
Internal Validity	Well covered

Question: In adults presenting with chest pain/discomfort of acute suspected cardiac origin, what is the clinical and cost effectiveness of anti-platelet therapy (aspirin, clopidogrel alone or in combination) compared with a placebo?

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Barbash IM;Freimark D;Gottlieb S;Hod H;Hasin Y;Battler A;Crystal E;Matetzky S;Boyko V;Mandelzweig L;Behar S;Leor J;

Outcome of myocardial infarction in patients treated with aspirin is enhanced by pre-hospital administration

Ref ID 10246 Cardiology pgs: 141 to 147 2002

Study Type Cohort **Funding** Not reported

Number of participant 922 patients were included in total; 338 received aspirin before admission to hospital, 584 received aspirin after admission to hospital

Inclusion/Exclusion Criteria Included: Patients who were admitted to hospital with acute myocardial infarction, who received aspirin treatment either before or after admission or hospital.
Excluded: Those who had cardiogenic shock were excluded

Patient Characteristics

Aspirin before admission to hospital

Mean age	60.9 ± 13
Patients	
<59 years	174 (51%)
60-69 years	75 (22%)
>70 years	92 (27%)
Women	57 (17%)
Diabetes	92 (27%)
Hypertension	136 (40%)
Hyperlipidaemia	159 (47%)
Current smokers	158 (47%)
Prior MI	82 (24%)
Prior angina	98 (29%)
Prior heart failure	13 (4%)
Prior PTCA	49 (15%)
Prior CABG	14 (4%)
PVD	24 (7%)
History of stroke	21 (6%)
Gastrointestinal disorder	31 (9%)
Typical chest pain	318 (94%)
MICU transport	230 (68%)
Anterior MI	159 (47%)
Spontaneous reperfusion	20 (5.9%)

Aspirin after admission to hospital

Mean age	64.5 ± 14
Patients	
<59 years	224 (41%)
60-69 years	114 (20%)
>70 years	222 (39%)
Women	157 (27%)
Diabetes	184 (32%)
Hypertension	248 (43%)
Hyperlipidaemia	241 (42%)
Current smokers	222 (39%)
Prior MI	114 (20%)
Prior angina	154 (27%)
Prior heart failure	33 (6%)
Prior PTCA	51 (9%)
Prior CABG	11 (2%)
PVD	48 (8%)
History of stroke	51 (9%)
Gastrointestinal	

	disorder 74 (13%) Typical chest pain 469 (80%) MICU transport 90 (15%) Anterior MI 260 (45%) Spontaneous reperfusion 20 (3.4%)
Recruitment	Patients who were admitted to 26 coronary care units and 82 medicine wards in 26 hospitals
Setting	Hospital, ambulance & community in Israel
Interventions/ Test/ Factor being investigated	Aspirin administration - dose of >200mg chewable aspirin before or after admission to hospital
Comparisons	Aspirin being given before or after admission to hospital
Length of Study/ Follow-up	Follow up at 7 and 30 days
Outcome measures studied	Mortality, in-hospital complications, in-hospital treatments
Results	Aspirin given: before hospital after hospital P value All cause Mortality 7 days 8 (2.4%) 42 (7.3%) 0.002 30 days 16 (4.9%) 64 (11.1%) 0.001 Re-hospitalisation Non-cardio 5 (13%) 23 (22%) 0.22 Cardiovascular 59 (19%) 134 (27%) 0.02 In-hospital complications Asystole 6 (2%) 39 (7%) < 0.001 Resuscitation 12 (4%) 55 (9%) < 0.001 Ventilation 17 (5%) 66 (11%) 0.001 There was no significant difference in the following in-hospital complications recurrent MI, pulmonary oedema, sustained VT, primary VF, free wall rupture, ventricular septal defect, significant MR and cardiogenic shock In-hospital medications Ticlopidine / clopidogrel 84 (25%) 75 (13%) < 0.001 IIb/IIIa antagonists 97 (29%) 120 (21%) 0.005 Heparin 301 (90%) 466 (80%) < 0.001 Primary reperfusion 219 (65%) 299 (51%) < 0.001 There was no significant difference in in-hospital management in the following drug therapies: aspirin, vasopressors, β-blockers, calcium blockers, nitrates, diuretics, ACE inhibitors, angiotensin-II antagonist, lipid lowering drugs and digitalis In-hospital procedures Coronary angiography 195 (58%) 252 (44%) < 0.001 PTCA 136 (41%) 155 (27%) < 0.001 There was no significant difference in in-hospital management in the following procedures: CABG, intra-aortic balloon pump, pulmonary artery catheter

	Patients, n(%)					
	Primary reperfusion (n=518)			no primary reperfusion (n=404)		
	Early	Late	p value	Early	Late	p value
Age, years	59±12	60±12	0.1	65±13	69±14	0.007
Women	30(14%)	64(21%)	0.02	27(23%)	93(33%)	0.05
Prior MI	54(25%)	53(18%)	0.05	28(23%)	61(22%)	0.69

Prior angina	59(27%)	73(24%)	0.53	39(33%)	81(29%)	0.41
Prior heart failure	5(2%)	8(3%)	0.77	8(7%)	25(9%)	0.47
Prior PTCA	36(16%)	35(12%)	0.13	13(11%)	16(6%)	0.07
Prior CABG	7(3%)	6 (2%)	0.39	7(6%)	5(2%)	0.03
Hypertension	86(39%)	108(36%)	0.50	50(42%)	140(50%)	0.16
Diabetes	60(27%)	89(30%)	0.54	32(27%)	95(34%)	0.17
Hypertension	109(50%)	143(48%)	0.64	50(42%)	98(35%)	0.16
Current smokers	111(51%)	129(44%)	0.13	47(40%)	93(33%)	0.19
Anterior MI	106(48%)	138(46%)	0.31	53(46%)	122(44%)	0.70
Thrombolysis	178(81%)	251(84%)	0.43	0(0%)	0(0%)	
Primary PTCA	43(20%)	50(17%)	0.39	0(0%)	0(0%)	
30-day cardiovascular re-hospitalisation	39(19%)	71(26%)	0.07	20(20%)	63(27%)	0.15
Mortality – 7 D	3(1.4%)	17(5.8%)	0.01	5(4.4%)	25(8.9%)	0.13
Mortality 30 D	7(3.3%)	20(6.8%)	0.08	9(8.0%)	44(15.7%)	0.04

Safety and adverse effects

The paper does not state any adverse events caused by the aspirin administration in patients with a MI

Does the study answer the question?

This study addresses the key clinical question of the effect of aspirin administration, however this is on patients who have an acute MI not those with undifferentiated chest pain. The study suggests that giving aspirin early results in lower mortality rates at 7 and 30 days and a lower rate of re-hospitalisation. This benefit was also seen in a sub-group analysis of patients who underwent reperfusion. The study showed that those who received aspirin before admission to hospital were more likely to be treated with heparin, ticlopidine / clopidogrel, IIb/IIIa antagonists. The paper states that the theoretical basis of early aspirin administration is due to the anti-platelet properties and its ability to aid reperfusion.

Effect due to factor in study?

Yes

Consistency of results with other studies?

Limited studies in this area, results appear consistent

Directly applicable to guideline population?

Population have a confirmed diagnosis of MI, intervention correct

Internal Validity

Well covered

Question 11: What is the utility and cost effectiveness of cardiac biomarkers in evaluation of individuals with acute chest pain of suspected cardiac origin?

Grading: 1++ High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias

Balk EM;Ioannidis JP;Salem D;Chew PW;Lau J;

Accuracy of biomarkers to diagnose acute cardiac ischemia in the emergency department: a meta-analysis

Ref ID 215 Ann Emerg Med pgs: 478 to 494 2001

Study Type Meta-analysis **Funding** Agency for Healthcare Research and Quality

Number of participant 73 diagnostic studies searched from 1966 to December 1998

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

The meta-analysis evaluated the accuracy of biomarkers to diagnose acute cardiac ischemia in the emergency department. The analysis searched for papers examining the diagnostic performance of troponin I, troponin T, creatine kinase, CK-MB, myoglobin and CK-MB with myoglobin from 1966 to December 1998. The analysis considered 73 papers which considered the diagnosis of AMI. Where possible the authors only analyse papers which considered patients in emergency departments and the review took study quality into account when analysing the results. The study did not report the timing of the tests.

The analysis identified 7 studies which evaluated the diagnostic performance of single troponin I, the review reported the timing of the tests for two studies, one was at 2 hours from symptom onset and one was at 7 hours from onset of symptoms, but not for the other 5 studies. The prevalence of AMI ranged from 6%-39% in the studies with a total of 1149 patients included in the studies. The sensitivity ranged from 4% to 100% and the specificity ranged from 89% to 98% but 3 papers did not provide data for the specificity. The over all sensitivity was 39% and the specificity was 93%. For serial troponin I testing 2 studies were identified which had 6% and 9% prevalence of AMI and included 1393 patients. The review did not report the timing of the serial troponin I tests. The studies showed a sensitivity of 95% and specificity of 90% (sensitivity range 90%-100% and specificity range 83%-96%).

The analysis identified 8 studies which evaluated the diagnostic performance of single troponin T. The tests were conducted on admission to the emergency

department. The prevalence of AMI ranged from 6%-78% in the studies with a total of 1348 patients included in the studies. The sensitivity ranged from 15% to 53% and the specificity ranged from 89% to 98%. The over all sensitivity was 39% and the specificity was 93%. For serial troponin T testing 4 studies were identified which had 5% to 78% prevalence of AMI and included 904 patients. The review did not report the timing of the serial troponin T tests. The studies showed a sensitivity of 93% and specificity of 85% (sensitivity range 65%-100% and specificity range 86%-93%).

The analysis identified 12 studies which evaluated the diagnostic performance of single CK. The tests were conducted on admission to the emergency department. The prevalence of AMI ranged from 7%-41% in the studies with a total of 3195 patients included in the studies. The sensitivity ranged from 7% to 55% and the specificity ranged from 65% to 96%. The over all sensitivity was 37% and the specificity was 87%. For serial CK testing 2 studies were identified which had 26% and 43% prevalence of AMI and included 786 patients. The review did not report the timing of the serial CK tests. The studies showed a sensitivity of 83% and specificity of 76% (sensitivity range 69%-99% and specificity range 68%-84%).

The analysis identified 19 studies which evaluated the diagnostic performance of single CK-MB. The tests were conducted on admission to the emergency department. The prevalence of AMI ranged from 6%-42% in the studies with a total of 6425 patients included in the studies. The sensitivity ranged from 14% to 100% and the specificity ranged from 86% to 100%. The over all sensitivity was 42% and the specificity was 97%. For serial CK-MB testing 14 studies were identified which had 1% to 43% prevalence of AMI and included 11625 patients. The review did not report the timing of the serial CK-MB tests. The studies showed a sensitivity of 79% and specificity of 96% (sensitivity range 41%-100% and specificity range 92%-100%).

The analysis identified 18 studies which evaluated the diagnostic performance of single myoglobin. The tests were conducted on admission to the emergency department. The prevalence of AMI ranged from 6%-62% in the studies with a total of 4172 patients included in the studies. The sensitivity ranged from 21% to 100% and the specificity ranged from 61% to 100%. The over all sensitivity was 49% and the specificity was 91%. For serial myoglobin testing 14 studies were identified which had 11% to 37% prevalence of AMI and included 1277 patients. The review did not report the timing of the serial myoglobin tests. The studies showed a sensitivity of 89% and specificity of 87% (sensitivity range 57%-100% and specificity range 72%-100%).

The analysis identified 3 studies which evaluated the diagnostic performance of single CK-MB and myoglobin. Two of the studies included conducted the tests at presentation and one was 2 hours from presentation. The prevalence of AMI ranged from 9%-28% in the studies with a total of 2283 patients included in the studies. The sensitivity ranged from 62% to 100% and the specificity ranged from 72% to 80%. The over all sensitivity was 83% and the specificity was 82%. For serial CK-MB and myoglobin testing 2 studies were identified which had 11% and 20% prevalence of AMI and included 291 patients. The review did not report the timing of the serial CK-MB and myoglobin tests. The studies showed a sensitivity of 100% and specificity of 83% (specificity range 75%-91%)

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Ebell MH;Flewelling D;Flynn CA;

A systematic review of troponin T and I for diagnosing acute myocardial infarction

Ref ID	234	J Fam Pract	pgs:	550	to	556	2000

Study Type	Systematic Review	**Funding**	American Academy of Family Physicians and its members

Number of participant	19 diagnostic studies search until December 1999
Inclusion/Exclusion Criteria	
Patient Characteristics	
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	
Comparisons	
Length of Study/ Follow-up	
Outcome measures studied	
Results	
Safety and adverse effects	
Does the study answer the question?	The systematic review evaluated troponin T and I for diagnosing AMI. The review searched for papers examining the diagnostic performance of troponin T and troponin I until December 1999. The review considered 19 papers which considered the diagnosis of AMI in patients with acute chest pain, presenting to an emergency department, that included the sensitivity or specificity for at least one biomarker at a set time. The study identified 6 studies which evaluated the diagnostic value of troponin I in diagnosing AMI. The review did not report the prevalence of AMI in the test population but it did report a meta-analysis of the sensitivity and specificity of troponin I at 1, 2, 3, 4, 5 and 6 hours from onset of pain. (See table in question 11 appendix for full results) The highest sensitivity occurred at 6 hours from onset of pain and was 90% and had a specificity of 95%. The review identified 14 studies which evaluated the diagnostic value of troponin T in diagnosing AMI. Again the review did not report the prevalence of AMI in the test population but did report sensitivity and specificity for troponin T > 0.1 and for troponin T >0.2 at 1, 2, 3, 4, 6, 8 and 10 hours after onset of pain. (See table in question 11 appendix for full results). The highest sensitivity for troponin T > 0.1 occurred at 10 hours from onset of pain and was 93% and had a specificity of 80%, but had the highest specificity at 1 and 2 hours from onset which had a specificity of 87% but sensitivity of 47% and 53% respectively. The highest sensitivity for troponin T > 0.2 occurred at 8 and 10 hours from onset of pain and was 96% and had a specificity of 81% and 80% respectively, but had the highest specificity at 1 and 2 hours from onset which had a specificity of 87% but sensitivity of 14% and 33% respectively.
Effect due to factor in study?	
Consistency of results with other studies?	

Directly applicable to guideline population?

Internal Validity

Mant J;McManus RJ;Oakes RL;Delaney BC;Barton PM;Deeks JJ;Hammersley L;Davies RC;Davies MK;Hobbs FR;

Systematic review and modelling of the investigation of acute and chronic chest pain presenting in primary care

Ref ID 728 Health technology assessment pgs: 1 to 158 2004

Study Type Economic **Funding**

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Guo X;Feng J;Guo H;

The predictive value of the bedside troponin T test for patients with acute chest pain

Ref ID 1321 Experimental and Clinical Cardiology pgs: 298 to 301 2006

Study Type Diagnostic

Funding Science Research Fund of Guangzhou Red Cross Hospital

Number of participant	502 patients Patients were included if they had chest pain of suspected AMI, patients were admitted to the cardiac department or CCU 89.1% had AMI (86.9% had TnT+ and 2.2% had TnT-)
Inclusion/Exclusion Criteria	
Patient Characteristics	Diagnosing AMI
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	Troponin T at admission and 6 and 12 hours after admission
Comparisons	No comparison
Length of Study/ Follow-up	
Outcome measures studied	
Results	For results see Table 1 in Question 11 appendix
Safety and adverse effects	
Does the study answer the question?	
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	
Internal Validity	

Kost GJ;Kirk JD;Omand K;

A strategy for the use of cardiac injury markers (troponin I and T, creatine kinase-MB mass and isoforms, and myoglobin) in the diagnosis of acute myocardial infarction

Ref ID 293 Arch Pathol Lab Med pgs: 245 to 251 1998

Study Type Diagnostic

Funding Equipment and reagents were provided by vendors (names not reported)

Number of participant	97 patients Patients were included if they had acute chest pain which was possible AMI, presenting to the emergency department 28% had AMI
Inclusion/Exclusion Criteria	
Patient Characteristics	Diagnosing AMI
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	Troponin T, troponin I, CK-MB and myoglobin at presentation and 3, 6 and 12 hours after admission
Comparisons	Biomarkers were compared to each other
Length of Study/ Follow-up	
Outcome measures studied	
Results	For results see Table 1 in Question 11 appendix
Safety and adverse effects	
Does the study answer the question?	
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	
Internal Validity	

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Alp NJ;Bell JA;Shahi M;

A rapid troponin-I-based protocol for assessing acute chest pain

Ref ID 780 | QJM - Monthly Journal of the Association of Physicians | pgs: 687 to 694 | 2001

Study Type Diagnostic **Funding** Not reported

Number of participant	397 patients Patients were included if they were aged over 18 years old, had acute chest pain of possible cardiac origin admitted to the CCU Patients were excluded if evidence of ST elevation on admission ECG, evidence of MI in previous 2 weeks, inability to provide informed consent 28% had AMI
Inclusion/Exclusion Criteria	
Patient Characteristics	Diagnosing chest pain
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	Troponin I at 6 hours from onset of worst symptoms or from presentation if timing of symptoms was unclear
Comparisons	Standard management (CK, AST and ECG)
Length of Study/ Follow-up	
Outcome measures studied	
Results	For results see Table 1 in Question 11 appendix
Safety and adverse effects	
Does the study answer the question?	
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	
Internal Validity	

Chiu A;Chan WK;Cheng SH;Leung CK;Choi CH;

Troponin-I, myoglobin, and mass concentration of creatine kinase-MB in acute myocardial infarction

Ref ID 10340 | QJM - Monthly Journal of the Association of Physicians | pgs: 711 to 718 | 1999

Study Type Diagnostic **Funding** Not reported

Number of participant 87 patients
Patients were included if they had an initial diagnosis of AMI, patients presented to the emergency department or cardiac ward

86.2% had transmural infarction, 13.8% had non-Q wave myocardial infarction

Inclusion/Exclusion Criteria

Patient Characteristics Confirming a diagnosis of AMI

Recruitment

Setting

Interventions/ Test/ Factor being investigated CK-MB, troponin I, myoglobin, triple test (troponin I, myoglobin and CK-MB) at a mean of 4.89 hours over 72 hours from onset of pain

Comparisons Each biomarker is compared to each other and a confirmed diagnosis of AMI is based on the WHO definition

Length of Study/ Follow-up

Outcome measures studied

Results For results see Table 1 in Question 11 appendix

Safety and adverse effects

Does the study answer the question?

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Eggers KM;Oldgren J;Nordenskj÷ld A;Lindahl B;

Diagnostic value of serial measurement of cardiac markers in patients with chest pain: limited value of adding myoglobin to troponin I for exclusion of myocardial infarction

Ref ID 608 | Am Heart J | pgs: to 81 | 2004

Study Type Diagnostic **Funding** Dade Behring Inc. and Cardiological Decision Support Uppsala AB,

	Uppsala, Sweden
Number of participant	197 consecutive patients with chest pain and a non diagnostic ECG Patients were included if they had had chest pain for longer than 15 minutes within the last 24 hours which was suspected to be unstable angina or AMI and admitted to the CCU Patients were excluded if they had pathological ST-segment elevation on the admission ECG leading to immediate reperfusion 22% had AMI
Inclusion/Exclusion Criteria	
Patient Characteristics	Excluding an AMI diagnosis
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	Myoglobin with troponin I, CK-MB at presentation at 6 and 12 hours after presentation
Comparisons	Troponin I
Length of Study/ Follow-up	
Outcome measures studied	
Results	For results see Table 1 in Question 11 appendix
Safety and adverse effects	
Does the study answer the question?	
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	
Internal Validity	

Falahati A;Sharkey SW;Christensen D;McCoy M;Miller EA;Murakami MA;

Implementation of serum cardiac troponin I as marker for detection of acute myocardial infarction

Ref ID 1983 Am Heart J pgs: 332 to 337 1999

Study Type Diagnostic **Funding** Dade International Inc.

Number of participant	327 consecutive patients over a 3 month period were evaluated for AMI. Patients were excluded if less than 2 blood samples were taken. The study was conducted at the Hennepin county Medical centre, Minneapolis, USA 19% had a final diagnosis of AMI (of which 79% had a diagnostic ECG and 21% had a non diagnostic ECG)

Inclusion/Exclusion Criteria	
Patient Characteristics	The diagnosis of AMI
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	All patients had CK, CK-MB and CTnI tested every 6-8 hours from admission for 24-48 hours
Comparisons	The tests were compared to each other and the AMI diagnosis was based on the WHO diminution
Length of Study/ Follow-up	
Outcome measures studied	
Results	For results see Table 1 in Question 11 appendix
Safety and adverse effects	
Does the study answer the question?	
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	
Internal Validity	

Fesmire FM;Christenson RH;Fody EP;Feintuch TA;

Delta creatine kinase-MB outperforms myoglobin at two hours during the emergency department identification and exclusion of troponin positive non-ST-segment elevation acute coronary syndromes

Ref ID 629 Ann Emerg Med pgs: 12 to 19 2004

Study Type	Diagnostic	**Funding**	Phillips Medical Systems, Millennium Pharmaceuticals Inc, Bristol-Myers Squibb Medical Imaging and EmCare Inc.

Number of participant	975 patients Patients were included if they had a baseline troponin level of 1.0 ng/ml or less and an initial non-diagnostic ECG , presenting to a University hospital, USA 4.5% had AMI
Inclusion/Exclusion Criteria	
Patient Characteristics	Diagnosing AMI

Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	CK-MB, myoglobin at 2 hours from presentation
Comparisons	no comparison
Length of Study/ Follow-up	
Outcome measures studied	
Results	For results see Table 1 in Question 11 appendix
Safety and adverse effects	
Does the study answer the question?	
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	
Internal Validity	

Gust R;Gust A;B÷ttiger BW;B÷hrer H;Martin E;

Bedside troponin T testing is not useful for early out-of-hospital diagnosis of myocardial infarction

Ref ID 2014 Acta Anaesthesiol Scand pgs: 414 to 417 1998

Study Type Diagnostic **Funding** Not reported

Number of participant	68 patients Patients were included if they had chest pain strongly suspected of AMI, (pain radiated to neck or one or both shoulders which was not relieved by rest or sublingual glyceryl trinitrate), presenting to the emergency department 24% had AMI
Inclusion/Exclusion Criteria	
Patient Characteristics	Diagnosing AMI
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	Troponin T
Comparisons	no comparison

Length of Study/ Follow-up

Outcome measures studied

Results For results see Table 1 in Question 11 appendix

Safety and adverse effects

Does the study answer the question?

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Planer D;Leibowitz D;Paltiel O;Boukhobza R;Lotan C;Weiss TA;

The diagnostic value of troponin T testing in the community setting

Ref ID 513 Int J Cardiol pgs: 369 to 375 2006

Study Type Diagnostic

Funding Kits were provided by DYN Diagnostics, Israel

Number of participant

349 patients
Patients were included if they were aged over 30 years, with at least 20 consecutive minutes of chest pain beginning at least 8 hours before presentation and occurring within the last 6 days
Patients were excluded if the had renal failure, ST elevation on ECG, had a diagnosis of ACS or had undergone revascularization
Patients were recruited from 44 community clinics in Jerusalem, Israel
1.7% had AMI

Inclusion/Exclusion Criteria

Patient Characteristics Diagnosing AMI

Recruitment

Setting

Interventions/ Test/ Factor being investigated Troponin T

Comparisons No comparison

Length of Study/ Follow-up

Outcome measures studied

Results For results see Table 1 in Question 11 appendix

Safety and adverse effects

Does the study answer the question?

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Zarich S;Bradley K;Seymour J;Ghali W;Traboulsi A;Mayall ID;Bernstein L;

Impact of troponin T determinations on hospital resource utilization and costs in the evaluation of patients with suspected myocardial ischemia

Ref ID 10352 Am J Cardiol pgs: 732 to 736 2001

Study Type Economic **Funding**

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Zarich SW;Qamar AU;Werdmann MJ;Lizak LS;McPherson CA;Bernstein LH;

Value of a single troponin T at the time of presentation as compared to serial CK-MB determinations in patients with suspected myocardial ischemia

Ref ID 731 Clin Chim Acta pgs: 185 to 192 2002

Study Type	Diagnostic	**Funding**	Not reported

Number of participant	267 patients Patients were included if they had a complete evaluation including biomarkers, presenting to the emergency department Patients were excluded if they had a history of chest trauma or renal failure 32% had AMI or unstable angina
Inclusion/Exclusion Criteria	
Patient Characteristics	Diagnosing AMI
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	Single troponin T, CK-MB at presentation and serial CK-MB at presentation, 4, 8 and 16 hours after presentation
Comparisons	Compared to each other
Length of Study/ Follow-up	
Outcome measures studied	
Results	For results see Table 1 in Question 11 appendix
Safety and adverse effects	
Does the study answer the question?	
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	
Internal Validity	

Grading: 2-	Case–control or cohort studies with a high risk of confounding bias, or chance and a significant risk that the relationship is not causal*

al Harbi K;Suresh CG;Zubaid M;Akanji AO;

Establishing a gradient of risk in patients with acute coronary syndromes using troponin I measurements

Ref ID 748 Medical Principles and Practice pgs: 18 to 22 2002

Study Type Diagnostic **Funding** Not reported

Number of participant	124 patients (group 1 = 86 patients, group 2 = 38 patients) Patients were included in group 1if they had a diagnosis of ACS, group 2 were 38 healthy age-matched patients with no history of cardiovascular disease or any other chronic disease Group 1 patients were admitted to the CCU 59% had AMI, 41% had unstable angina
Inclusion/Exclusion Criteria	
Patient Characteristics	Diagnosing AMI and unstable angina
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	Troponin I at presentation and 8 and 16 hours from presentation
Comparisons	no comparison
Length of Study/ Follow-up	
Outcome measures studied	
Results	For results see Table 1 in Question 11 appendix
Safety and adverse effects	
Does the study answer the question?	
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	
Internal Validity	

Vatansever S;Akkaya V;Erk O;Ozt³rk S;Karan MA;Salmayenli N;Tasþioglu C;G³ler K;

The diagnostic value of troponin T and myoglobin levels in acute myocardial infarction: a study in Turkish patients

Ref ID 699 J Int Med Res pgs: 76 to 83 2003

Study Type Diagnostic **Funding** Not reported

Number of participant 60 patients
Patients were included for the study group if they had a confirmed AMI, and for the control group if they were members of the health profession who matched the study group for age and gender but did not have AMI
the study group presented to the emergency department
55% had AMI

Inclusion/Exclusion Criteria

Patient Characteristics Diagnosing AMI

Recruitment

Setting

Interventions/ Test/ Factor being investigated TroponinT and myoglobin at 2 hours from presentation

Comparisons CK

Length of Study/ Follow-up

Outcome measures studied

Results For results see Table 1 in Question 11 appendix

Safety and adverse effects

Does the study answer the question?

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

Internal Validity

Zimmerman J;Fromm R;Meyer D;Boudreaux A;Wun CC;Smalling R;Davis B;Habib G;Roberts R;

Diagnostic marker cooperative study for the diagnosis of myocardial infarction

Ref ID 897 Circulation pgs: 1671 to 1677 1999

Study Type Diagnostic **Funding** Boehringer Mannheim Corporation, Dade International, Helena Laboratories, Spectral Diagnostics, Inc, and NHLBI

(grant P50-HL-54313-01)

Number of participant	955 patients Patients were included if aged over 21 years old with chest pain lasting for 15 minutes or longer suspected to be myocardial in origin and occurring within 24 hours of presentation Patients presented to hospitals in Texas, USA 100% had AMI
Inclusion/Exclusion Criteria	
Patient Characteristics	Diagnosing AMI
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	CK-MB, troponin I, troponin T, myoglobin at 2, 4, 6, 8, 10, 18 and 22 hours after presentation
Comparisons	Biomarkers were compared with each other
Length of Study/ Follow-up	
Outcome measures studied	
Results	For results see Table 1 in Question 11 appendix
Safety and adverse effects	
Does the study answer the question?	
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	
Internal Validity	

Question 13: What is the incremental benefit and cost effectiveness of a clinical history, risk factors and physical examination in evaluation of individuals with stable chest pain of suspected cardiac origin?

Grading: 1++ High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias

Chun AA;McGee SR;

Bedside diagnosis of coronary artery disease: a systematic review

Ref ID 10275 The American journal of medicine pgs: 334 to 343 2004

Study Type Systematic Review **Funding** Not reported

Number of participant 64 studies

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

Most of the papers reviewed were of patients presenting with stable intermittent chest pain who were then referred for coronary angiography. Most of the studies had excluded patients with valvular heart disease or nonischemic cardiomyopathy. The studies used either >50% stenosis or 70-75% stenosis off any epicardial vessel as the diagnostic standard.
The study showed that for diagnosing CAD over all the physical examination gave little additional diagnostic information (see narrative for question 27; Table 1: Chun and McGee, 2004). The presence of an ear lobe crease gave a small increase to the probability of CAD (likelihood ratio (LR)=2.3). Arcus senilis and an ankle-brachial index <0.9 had no statistical significance, and the presence of chest wall tenderness was also diagnostically unhelpful.
The review calculated the LR by pooling the date from the included studies which used 2 diagnostic criteria for CAD (>50% stenosis and >70% to 75% stenosis). The study also analysed the data separately (>50% stenosis and >70-75% stenosis) which showed the pooled LRs remained the same. In studies which used > 50% stenosis the pooled LRs were 5.6 for typical angina, 1.1 for atypical angina, and 0.1 for nonanginal chest pain. The review calculated LRs including data from studies that combined patients with a history of MI with those without; the LRs were the same if only those studies excluding prior MI were analysed. In studies of patients without a history of MI the pooled likelihood ratios were 5.8 for typical angina, 1.3 for atypical angina and 0.1 for nonanginal chest pain.

The study showed that for the diagnosing MI, (see narrative for question 27; Table 2:

Chun and McGee, 2004 and Table 3: Chun and McGee, 2004) the ECG was more useful in diagnosing MI, however systolic blood pressure <100 mmHg (LR=3.6), diaphoresis on examination (LR=2.9), diastolic blood pressure <60 mmHg (LR=2.5), and presence of jugular venous distention (LR=2.4) were also helpful in diagnosing MI. a normal ECG was most useful in ruling out a diagnosis of MI but the patient having chest wall tenderness was also helpful for ruling out the diagnosis.

Effect due to factor in study? Yes

Consistency of results with other studies? Consistent

Directly applicable to guideline population? Correct population

Internal Validity

Chun AA;McGee SR;

Bedside diagnosis of coronary artery disease: a systematic review

Ref ID 10275 The American journal of medicine pgs: 334 to 343 2004

Study Type Systematic Review **Funding** Not reported

Number of participant 64 studies

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? Most of the papers reviewed were of patients presenting with stable intermittent chest pain who were then referred for coronary angiography. Most of the studies had excluded patients with valvular heart disease or nonischemic cardiomyopathy. The studies used either >50% stenosis or 70-75% stenosis off any epicardial vessel as the diagnostic standard.
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The review calculated the LR by pooling the date from the included studies which used 2 diagnostic criteria for CAD (>50% stenosis and >70% to 75% stenosis). The study also analysed the data separately (>50% stenosis and >70-75% stenosis) which showed the pooled LRs remained the same. In studies which used > 50% stenosis the pooled LRs were 5.6 for typical angina, 1.1 for atypical angina, and 0.1 for nonanginal chest pain. The review calculated LRs including data from studies that combined patients with a history of MI with those without; the LRs were the same if only those studies excluding prior MI were analysed. In studies of patients without a history of MI the pooled likelihood ratios were 5.8 for typical angina, 1.3 for atypical angina and 0.1 for nonanginal chest pain.

The study showed that for the diagnosing MI, (see narrative for question 26; Table 3: Chun and McGee, 2004 and Table 4: Chun and McGee, 2004) the ECG was more useful in diagnosing MI, however systolic blood pressure <100 mmHg (LR=3.6), diaphoresis on examination (LR=2.9), diastolic blood pressure <60 mmHg (LR=2.5), and presence of jugular venous distention (LR=2.4) were also helpful in diagnosing MI. a normal ECG was most useful in ruling out a diagnosis of MI but the patient having chest wall tenderness was also helpful for ruling out the diagnosis.

Effect due to factor in study? Yes

Consistency of results with other studies? Consistent

Directly applicable to guideline population? Correct population

Internal Validity

Chun AA;McGee SR;

Bedside diagnosis of coronary artery disease: a systematic review

Ref ID 10275 The American journal of medicine pgs: 334 to 343 2004

Study Type Systematic Review **Funding** Not reported

Number of participant 64 studies

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?	Most of the papers reviewed were of patients presenting with stable intermittent chest pain who were then referred for coronary angiography. Most of the studies had excluded patients with valvular heart disease or nonischemic cardiomyopathy. The studies used either >50% stenosis or 70-75% stenosis off any epicardial vessel as the diagnostic standard. The study showed that for diagnosing CAD over all the physical examination gave little additional diagnostic information (see narrative for question 28; Table 1: Chun and McGee, 2004). The presence of an ear lobe crease gave a small increase to the probability of CAD (likelihood ratio (LR)=2.3). Arcus senilis and an ankle-brachial index <0.9 had no statistical significance, and the presence of chest wall tenderness was also diagnostically unhelpful. The review calculated the LR by pooling the date from the included studies which used 2 diagnostic criteria for CAD (>50% stenosis and >70% to 75% stenosis). The study also analysed the data separately (>50% stenosis and >70-75% stenosis) which showed the pooled LRs remained the same. In studies which used > 50% stenosis the pooled LRs were 5.6 for typical angina, 1.1 for atypical angina, and 0.1 for nonanginal chest pain. The review calculated LRs including data from studies that combined patients with a history of MI with those without; the LRs were the same if only those studies excluding prior MI were analysed. In studies of patients without a history of MI the pooled likelihood ratios were 5.8 for typical angina, 1.3 for atypical angina and 0.1 for nonanginal chest pain. The study showed that for the diagnosing MI, (see narrative for question 28; Table 2: Chun and McGee, 2004 and Table 3: Chun and McGee, 2004) the ECG was more useful in diagnosing MI, however systolic blood pressure <100 mmHg (LR=3.6), diaphoresis on examination (LR=2.9), diastolic blood pressure <60 mmHg (LR=2.5), and presence of jugular venous distention (LR=2.4) were also helpful in diagnosing MI. a normal ECG was most useful in ruling out a diagnosis of MI but the patient having chest wall tenderness was also helpful for ruling out the diagnosis.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Diamond GA;Forrester JS;

Analysis of probability as an aid in the clinical diagnosis of coronary-artery disease

Ref ID 2196 The New England journal of medicine pgs: 1350 to 1358 1979

Study Type	Cohort	**Funding**	Not reported

Number of participant	4952 had coronary angiography, 23 996 autopsy (autopsy patients had died from other causes e.g. trauma and non-cardiac related diseases)
Inclusion/Exclusion Criteria	Not applicable
Patient Characteristics	Not applicable Patients were considered to have typical angina if they had substernal discomfort brought on by physical exertion and was relieved within 10 minutes through rest or nitroglycerin. Patients were considered to have atypical angina if they had discomfort which was either not substernal or was not bought on by exertion or not relieved after 10 minutes by rest or nitroglycerin. Patients were considered to have non-anginal discomfort if they did not have 1 or more of the above characteristics.
Recruitment	Not applicable
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Prevalence of CAD based on age, sex and symptoms
Comparisons	Coronary angiography in symptomatic patients and autopsy
Length of Study/ Follow-up	Not applicable
Outcome measures studied	Prevalence of CAD based on age, sex and symptoms
Results	See narrative for question 27; Table 4a: Diamond and Forrester, 1979, Table 4b: Diamond and Forrester, 1979 and Table 4c: Diamond and Forrester, 1979 (autopsy patients had died from other causes e.g. trauma and non-cardiac related diseases) See narrative for question 27; Table 4a: Diamond and Forrester, 1979 and Table: 4b: Diamond and Forrester, 1979 Table 4a shows the prevalence of CAD confirmed by coronary angiography in patients described as having “typical angina”, ”atypical angina” and “nonanginal chest pain” from 4952 patients. From the table it can be seen that the prevalence of disease in persons with typical angina is about 90%, where as atypical angina shows a 50% prevalence (P<0.001) and nonanginal chest pain a 16% prevalence (P<0.001). Table 4b summarises pathological data obtained from 23 996 autopsies, showing the mean prevalence of CAD to be 4.5%. The prevalence of CAD observed at autopsy is similar to that in asymptomatic patients confirmed by coronary angiography. Table 4b also shows that there are significant differences (P<0.001) in disease prevalence when patients are grouped by age and sex. From table 4a and 4b giving data of the estimate of disease likelihood when the patient’s age and sex are known and a second estimate when the presence or absence of symptoms are known. The pre-test likelihood of disease for any patients

	(according to any combination of age, sex and symptoms) was determined by conditional-probability analysis. The results of this analysis can be seen in table 4c which shows the results of all combinations of age, sex and symptoms, which shows a wide range of pre-test likelihoods. See narrative for question 27; Table 4c: Diamond and Forrester, 1979
Safety and adverse effects	None
Does the study answer the question?	The study reviewed the literature to estimate the pre-test likelihood of disease (defined by age, sex and symptoms), the results were analysed through Bayes' theorem of conditional probability. The studied described how the probability of CAD can be determined in a patient before testing from information readily obtained from clinical evaluation. The study showed that combining data of the estimate of disease likelihood when the patient's age and sex are known and a second estimate when the presence or absence of symptoms are known. The pre-test likelihood of disease for any patients based on any combination of age, sex and symptoms can be determined by conditional-probability analysis. The results of this analysis can be seen in table 3 which shows the results of all combinations of age, sex and symptoms, which shows a wide range of pre-test likelihoods
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients had chest pain
Internal Validity	Well covered

Diamond GA;Forrester JS;

Analysis of probability as an aid in the clinical diagnosis of coronary-artery disease

Ref ID 2196 The New England journal of medicine pgs: 1350 to 1358 1979

Study Type	Cohort	**Funding**	Not reported

Number of participant	4952 had coronary angiography, 23 996 autopsy (autopsy patients had died from other causes e.g. trauma and non-cardiac related diseases)
Inclusion/Exclusion Criteria	Not applicable
Patient Characteristics	Not applicable Patients were considered to have typical angina if they had substernal discomfort brought on by physical exertion and was relieved within 10 minutes through rest or nitroglycerin. Patients were considered to have atypical angina if they had discomfort which was either not substernal or was not bought on by exertion or not relieved after 10 minutes by rest or nitroglycerin. Patients were considered to have non-anginal discomfort if they did not have 1 or more of the above characteristics.
Recruitment	Not applicable
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Prevalence of CAD based on age, sex and symptoms
Comparisons	Coronary angiography in symptomatic patients and autopsy

Length of Study/ Follow-up	Not applicable
Outcome measures studied	Prevalence of CAD based on age, sex and symptoms
Results	See narrative for question 26; Table 4a: Diamond and Forrester, 1979, Table 4b: Diamond and Forrester, 1979 and Table 4c: Diamond and Forrester, 1979 (autopsy patients had died from other causes e.g. trauma and non-cardiac related diseases) See narrative for question 26; Table 4a: Diamond and Forrester, 1979 and Table: 4b: Diamond and Forrester, 1979 Table 4a shows the prevalence of CAD confirmed by coronary angiography in patients described as having “typical angina”, ”atypical angina” and “nonanginal chest pain” from 4952 patients. From the table it can be seen that the prevalence of disease in persons with typical angina is about 90%, where as atypical angina shows a 50% prevalence (P<0.001) and nonanginal chest pain a 16% prevalence (P<0.001). Table 4b summarises pathological data obtained from 23 996 autopsies, showing the mean prevalence of CAD to be 4.5%. The prevalence of CAD observed at autopsy is similar to that in asymptomatic patients confirmed by coronary angiography. Table 4b also shows that there are significant differences (P<0.001) in disease prevalence when patients are grouped by age and sex. From table 4a and 4b giving data of the estimate of disease likelihood when the patient’s age and sex are known and a second estimate when the presence or absence of symptoms are known. The pre-test likelihood of disease for any patients (according to any combination of age, sex and symptoms) was determined by conditional-probability analysis. The results of this analysis can be seen in table 4c which shows the results of all combinations of age, sex and symptoms, which shows a wide range of pre-test likelihoods. See narrative for question 26; Table 4c: Diamond and Forrester, 1979
Safety and adverse effects	None
Does the study answer the question?	The study reviewed the literature to estimate the pre-test likelihood of disease (defined by age, sex and symptoms), the results were analysed through Bayes' theorem of conditional probability. The studied described how the probability of CAD can be determined in a patient before testing from information readily obtained from clinical evaluation. The study showed that combining data of the estimate of disease likelihood when the patient’s age and sex are known and a second estimate when the presence or absence of symptoms are known. The pre-test likelihood of disease for any patients based on any combination of age, sex and symptoms can be determined by conditional-probability analysis. The results of this analysis can be seen in table 3 which shows the results of all combinations of age, sex and symptoms, which shows a wide range of pre-test likelihoods
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients had chest pain
Internal Validity	Well covered

Diamond,G.A.; Staniloff,H.M.; Forrester,J.S.; Pollock,B.H.; Swan,H.J.

Computer-assisted diagnosis in the noninvasive evaluation of patients with suspected coronary

Ref ID 10281 Journal of the American College of Cardiology pgs: 444 to 455 1983

Study Type Cohort **Funding** Not reported

Number of participant	1097, 70% men, 30% women
Inclusion/Exclusion Criteria	Inclusion: referred for non invasive testing for suspected CAD without previous MI or coronary bypass surgery
Patient Characteristics	Mean age 56±11 years Patients were considered to have typical angina if they had substernal discomfort brought on by physical exertion and was relieved within 10 minutes through rest or nitroglycerin. Patients were considered to have atypical angina if they had discomfort which was either not substernal or was not bought on by exertion or not relieved after 10 minutes by rest or nitroglycerin. Patients were considered to have non-anginal discomfort if they did not have 1 or more of the above characteristics.
Recruitment	Patients who were referred for noninvasive testing for suspected CAD at the Cedars-Sinai Medical Center Cardiac Stress Laboratories, USA, between 1st January1979 and 15th November 1980
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Risk factors for diagnosing CAD
Comparisons	Risk factors for diagnosing CAD
Length of Study/ Follow-up	Not reported
Outcome measures studied	Diagnosis of CAD
Results	46 patients had 0 diseased vessels, 21 patients had 1 diseased vessel, 46 patients had 2 diseased vessels, 57 patients had 3 diseased vessels, and 124 patients had 1 + 2 + 3 diseased vessels See narrative for question 26; Table 5: Diamond et al, 1983 CAD probability and angiography (diseased vessels = d.v.) Estimates before testing Mean probability: 0.291 d.v.=0, 0.595 d.v=1, 0.623 d.v=2, 0.660 d.v=3, 0.635 d.v.=1+2+3 Standard deviation: 0.259 d.v.=0, 0.342 d.v=1, 0.334 d.v=2, 0.327 d.v=3, 0.332 d.v.=1+2+3 Estimates before angiography Mean probability: 0.253 d.v.=0, 0.745 d.v=1, 0.772 d.v=2, 0.843 d.v=3, 0.800 d.v.=1+2+3 Standard deviation: 0.322 d.v.=0, 0.387 d.v=1, 0.321 d.v=2, 0.284 d.v=3, 0.315 d.v.=1+2+3 All estimates Test combinations: 500 d.v.=0, 316 d.v=1, 640 d.v=2, 724 d.v=3, 1680 d.v.=1+2+3 Mean probability: 0.304 d.v.=0, 0.557 d.v=1, 0.730 d.v=2, 0.746 d.v=3, 0.704 d.v.=1+2+3 Standard deviation: 0.321 d.v.=0, 0.377 d.v=1, 0.323 d.v=2, 0.331 d.v=3, 0.322 d.v.=1+2+3
Safety and adverse effects	None
Does the study answer the question?	The study considered the probability of CAD and the disease prevalence. This showed that there was no significant difference between the predicted probability and the probability shown on angiography if probability was based on the age and sex of the patient, within the difference symptom classes. This, the authors states, shows the importance of clinical history as a diagnostic test. The study stated that the probability of CAD in each symptom class was consistently slightly higher in the patients with CAD compared to those without CAD, which the authors suggest shows that the Framingham risk factors were “modest discriminators

for CAD independent of symptom classification". The data the study gained was assessed based on the age, sex, symptoms and risk factors before diagnostic testing, and based on all the data gained before catheterization and again with all the data after every test had been carried out. For each assessment the probability of disease increased in proportion to the number of diseased vessels, however there were large standard deviations.

The study showed that the mean probability for CAD increased from 30% for the patients in the normal group to 56% for the patients with 1 vessel disease, and increased to 75% for patients with 3 vessel disease. There was overlap between data sets especially for those with 2 and 3 vessel disease, which showed no significant difference. This, the study stated, led to 8% of the probability estimates for the normal patients being in excess of 90%, and for 9.7% of the probability estimates for the patients with disease shown on angiography to be 10% under. There was a 3.4% difference between predicted probability and actually probability of CAD from the estimate based on sex, age ,symptoms and risk factors. The study used graphs to determine relationships between the variables and disease prevalence, and showed that the calculated probability of CAD accurately reflected the actual angiographic disease prevalence. See narrative for question 26; Figure 1: Diamond et al, 1983 and Figure 2 Diamond et al, 1983

The study also assessed the probability of CAD and extent of disease. This showed that when the patient had a probability of below "25% when disease was present single vessel disease was slightly more prevalent than multi-vessel disease, while above a probability of 75% multi-vessel disease predominated. At a probability of 100% multi-vessel disease accounted for 89% of all angiographic disease". The significance of these differences varied, however it shows that it does indicate that disease probability also acted as a quantitative measure of anatomic severity.

Effect due to factor in study? Yes

Consistency of results with other studies? Consistent

Directly applicable to guideline population? Patients had suspected CAD

Internal Validity Well covered

Diamond,G.A.; Staniloff,H.M.; Forrester,J.S.; Pollock,B.H.; Swan,H.J.

Computer-assisted diagnosis in the noninvasive evaluation of patients with suspected coronary

Ref ID 10281 Journal of the American College of Cardiology pgs: 444 to 455 1983

Study Type Cohort **Funding** Not reported

Number of participant 1097, 70% men, 30% women

Inclusion/Exclusion Criteria Inclusion: referred for non invasive testing for suspected CAD without previous MI or coronary bypass surgery

Patient Characteristics Mean age 56±11 years
Patients were considered to have typical angina if they had substernal discomfort brought on by physical exertion and was relieved within 10 minutes through rest or nitroglycerin.
Patients were considered to have atypical angina if they had discomfort which was either not substernal or was not bought on by exertion or not relieved after 10 minutes by rest or nitroglycerin.
Patients were considered to have non-anginal discomfort if they did not have 1 or more of the above characteristics.

Recruitment Patients who were referred for noninvasive testing for suspected CAD at the Cedars-Sinai Medical Center Cardiac Stress Laboratories, USA, between 1st January1979 and 15th November 1980

Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Risk factors for diagnosing CAD
Comparisons	Risk factors for diagnosing CAD
Length of Study/ Follow-up	Not reported
Outcome measures studied	Diagnosis of CAD
Results	46 patients had 0 diseased vessels, 21 patients had 1 diseased vessel, 46 patients had 2 diseased vessels, 57 patients had 3 diseased vessels, and 124 patients had 1 + 2 + 3 diseased vessels See narrative for question 27; Table 5: Diamond et al, 1983 CAD probability and angiography (diseased vessels = d.v.) Estimates before testing Mean probability: 0.291 d.v.=0, 0.595 d.v=1, 0.623 d.v=2, 0.660 d.v=3, 0.635 d.v.=1+2+3 Standard deviation: 0.259 d.v.=0, 0.342 d.v=1, 0.334 d.v=2, 0.327 d.v=3, 0.332 d.v.=1+2+3 Estimates before angiography Mean probability: 0.253 d.v.=0, 0.745 d.v=1, 0.772 d.v=2, 0.843 d.v=3, 0.800 d.v.=1+2+3 Standard deviation: 0.322 d.v.=0, 0.387 d.v=1, 0.321 d.v=2, 0.284 d.v=3, 0.315 d.v.=1+2+3 All estimates Test combinations: 500 d.v.=0, 316 d.v=1, 640 d.v=2, 724 d.v=3, 1680 d.v.=1+2+3 Mean probability: 0.304 d.v.=0, 0.557 d.v=1, 0.730 d.v=2, 0.746 d.v=3, 0.704 d.v.=1+2+3 Standard deviation: 0.321 d.v.=0, 0.377 d.v=1, 0.323 d.v=2, 0.331 d.v=3, 0.322 d.v.=1+2+3
Safety and adverse effects	None
Does the study answer the question?	The study considered the probability of CAD and the disease prevalence. This showed that there was no significant difference between the predicted probability and the probability shown on angiography if probability was based on the age and sex of the patient, within the difference symptom classes. This, the authors states, shows the importance of clinical history as a diagnostic test. The study stated that the probability of CAD in each symptom class was consistently slightly higher in the patients with CAD compared to those without CAD, which the authors suggest shows that the Framingham risk factors were “modest discriminators for CAD independent of symptom classification”. The data the study gained was assessed based on the age, sex, symptoms and risk factors before diagnostic testing, and based on all the data gained before catheterization and again with all the data after every test had been carried out. For each assessment the probability of disease increased in proportion to the number of diseased vessels, however there were large standard deviations. The study showed that the mean probability for CAD increased from 30% for the patients in the normal group to 56% for the patients with 1 vessel disease, and increased to 75% for patients with 3 vessel disease. There was overlap between data sets especially for those with 2 and 3 vessel disease, which showed no significant difference. This, the study stated, led to 8% of the probability estimates for the normal patients being in excess of 90%, and for 9.7% of the probability estimates for the patients with disease shown on angiography to be 10% under. There was a 3.4% difference between predicted probability and actually probability of CAD from the estimate based on sex, age ,symptoms and risk factors. The study used graphs to determine relationships between the variables and disease prevalence, and showed that the calculated probability of CAD accurately reflected the actual angiographic disease prevalence. See narrative for question 27; Figure 1: Diamond et al, 1983 and

Figure 2: Diamond et al, 1983

The study also assessed the probability of CAD and extent of disease. This showed that when the patient had a probability of below “25% when disease was present single vessel disease was slightly more prevalent than multi-vessel disease, while above a probability of 75% multi-vessel disease predominated. At a probability of 100% multi-vessel disease accounted for 89% of all angiographic disease”. The significance of these differences varied, however it shows that it does indicate that disease probability also acted as a quantitative measure of anatomic severity.

Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients had suspected CAD
Internal Validity	Well covered

Pryor DB;Harrell FE;Lee KL;Califf RM;Rosati RA;

Estimating the likelihood of significant coronary artery disease

Ref ID 10283 The American journal of medicine pgs: 771 to 780 1983

Study Type	Cohort	**Funding**	Not reported
Number of participant	3627 in training population, 1811 in test population		
Inclusion/Exclusion Criteria	Patients with chest pain who were referred for cardiac catheterization at the Duke University Medical Center between November 1969 and January 1982		
Patient Characteristics	Patient characteristics which were collected were: History: age, sex, chest pain history (pain type, severity, frequency, nocturnal, progressive, preinfarctional), duration of CAD, previous history of MI, congestive heart failure, history of vascular disease (Progressive chest pain - the frequency, severity or duration had increased in the 6 weeks prior to catherisation; Preinfarctional chest pain - a very unstable pain pattern that resulted in admission to the coronary care unit for evaluation of the possible MI) Risk factors: smoking, hyperlipidaemia, hypertension, diabetes, family history Physical examination: ventricular gallop, systolic blood pressure ECG: ST-T wave changes, electrocardiographic premature ventricular contractions, Electrocardiographic Q waves Chest X-Ray: cardiomegaly		
Recruitment	Patients admitted for cardiac catheterisation between November 1969 and January 1982		
Setting	Secondary care, USA		
Interventions/ Test/ Factor being investigated	Chest pain diagnosis		
Comparisons	Patient characteristics which give a probability of disease		
Length of Study/ Follow-up			

Outcome measures studied

Probability of disease

Results

The study had a training population of 3627 patients who were seen between 1969 and January 1979, from these patients a stepwise logistic regression analysis was used to develop a model for predicting the probability of significant CAD. A test population of 1811 patients seen between January 1969 and January 1982, in this population the model developed in the test population was used to predict the probability of CAD for each patient.
The authors then tested the model in other populations (from CASS study) to estimate the prevalence of disease in subgroups of the patients in the literature (external validation)

Results from training population: See narrative for question 26; Table 6:Pryor et al, 1983
Clinically Important Characteristics and the Chi-squared:
Pain type (typical, atypical or nonanginal): 1091
Previous MI: 511
Sex: 187
Age: 119
Smoking: 79
Hyperlipidaemia: 26
ST-T wave changes: 28
Diabetes: 12

Interactions
age X sex
age X smoking
age X hyperlipidaemia
sex X smoking

Poor Clinical Predictors of Significant CAD and the Chi-squared: See narrative for question 26; Table 7:Pryor et al, 1983
Chest pain severity: 0.96
Chest pain frequency: 8.57
Nocturnal chest pain: 2.22
Progressive chest pain: 2.54
Preinfarction angina: 9.70
Vascular disease: 0.40
Duration of CAD: 9.16
Congestive heart failure: 0.59
Hypertension: 5.19
Family history: 6.39
Ventricular gallop: 1.06
Cardiomegaly: 1.41
Electrocardiographic premature ventricular contractions: 0.46

The results from the training group are shown under “Clinically Important Characteristics and the Chi-squared” in the order of their importance (chi-squared added to the model by the parameter, adjusting for the characteristics that precede it). The type of chest pain (typical, atypical or nonanginal) was the most important characteristic followed by previous MI, sex, age, smoking, hyperlipidaemia, ST-T wave changes on ECG, diabetes. The results above show the 4 significant interactions which were found.
The study also showed that in men the effect of an increasing age was more important than in women, smoking was more important for women than men, and that smoking and hyperlipidaemia were more important at younger ages. The results for the other characteristics which were found to have small or nonsignificant effects on the prevalence of disease are shown under “Poor Clinical Predictors of Significant CAD and the Chi-squared”

The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence. This was with the exception of the group with predicted estimates of 0.475 to 0.525 (this group 8 out of 34 patients, with significant disease). The median prediction for patients with disease was 94% compared with a median prediction of 33% for patients without disease. A predicted probability of significant disease > 0.83 was found in 75% of patients with disease and in less than 10% of patients with disease. A probability of significant disease < 0.33 was found in nearly 50% of patients without

disease and in less than 5% of patients with disease.

The authors then externally validated using the population from the CASS study. There was disagreement on patients classified as having nonanginal chest pain (where the greatest difference in predicted disease compared to observed disease was seen), but the predicted estimates from the model were nearly equal to the observed prevalence of disease. The predicted estimates from the model of the probability of significant disease were nearly identical to the observed prevalence for subgroups based on “age, sex and history of MI” or “age, sex and pain type”.

Safety and adverse effects

None

Does the study answer the question?

Progressive chest pain was described as being chest pain when the frequency, severity or duration had increased in the 6 weeks prior to catherisation. Preinfarctional chest pain was described as chest pain with a very unstable pain pattern that resulted in admission to the coronary care unit for evaluation of the possible MI

The results from the training population showed the type of chest pain (typical, atypical or nonanginal) was the most important characteristic followed by previous MI, sex, age, smoking, hyperlipidaemia, ST-T wave changes on ECG, diabetes. The study also showed that in men the effect of increasing age was more important than in women, smoking was more important for women than men, and that smoking and hyperlipidaemia were more important at younger ages. The study also found some characteristics to have small or nonsignificat effects on the prevalence of disease.

The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence. When comparing the model to an external population the study showed that the predicted estimates from the model were nearly equal to the observed prevalence of disease. The predicted estimates from the model of the probability of significant disease were nearly identical to the observed prevalence for subgroups based on “age, sex and history of MI” or “age, sex and pain type”. However the greatest difference in predicted disease compared to observed disease was seen in patients with nonanginal chest pain.

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

Patients had chest pain

Internal Validity

Well covered

Pryor DB;Harrell FE;Lee KL;Califf RM;Rosati RA;

Estimating the likelihood of significant coronary artery disease

Ref ID 10283 The American journal of medicine pgs: 771 to 780 1983

Study Type Cohort **Funding** Not reported

Number of participant

3627 in training population, 1811 in test population

Inclusion/Exclusion Criteria

Patients with chest pain who were referred for cardiac catheterization at the Duke University Medical Center between November 1969 and January 1982

Patient Characteristics

Patient characteristics which were collected were:
History: age, sex, chest pain history (pain type, severity, frequency, nocturnal, progressive, preinfarctional), duration of CAD, previous history of MI, congestive heart failure, history of vascular disease (Progressive chest pain - the frequency, severity or duration had increased in the 6 weeks prior to catherisation;

	Preinfarctional chest pain - a very unstable pain pattern that resulted in admission to the coronary care unit for evaluation of the possible MI) Risk factors: smoking, hyperlipidaemia, hypertension, diabetes, family history Physical examination: ventricular gallop, systolic blood pressure ECG: ST-T wave changes, electrocardiographic premature ventricular contractions, Electrocardiographic Q waves Chest X-Ray: cardiomegaly
Recruitment	Patients admitted for cardiac catheterisation between November 1969 and January 1982
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Chest pain diagnosis
Comparisons	Patient characteristics which give a probability of disease
Length of Study/ Follow-up	
Outcome measures studied	Probability of disease
Results	The study had a training population of 3627 patients who were seen between 1969 and January 1979, from these patients a stepwise logistic regression analysis was used to develop a model for predicting the probability of significant CAD. A test population of 1811 patients seen between January 1969 and January 1982, in this population the model developed in the test population was used to predict the probability of CAD for each patient. The authors then tested the model in other populations (from CASS study) to estimate the prevalence of disease in subgroups of the patients in the literature (external validation) Results from training population: See narrative for question 28; Table 4: Pryor et al, 1983 Clinically Important Characteristics and the Chi-squared: Pain type (typical, atypical or nonanginal): 1091 Previous MI: 511 Sex: 187 Age: 119 Smoking: 79 Hyperlipidaemia: 26 ST-T wave changes: 28 Diabetes: 12 Interactions age X sex age X smoking age X hyperlipidaemia sex X smoking Poor Clinical Predictors of Significant CAD and the Chi-squared: See narrative for question 28; Table 5: Pryor et al, 1983 Chest pain severity: 0.96 Chest pain frequency: 8.57 Nocturnal chest pain: 2.22 Progressive chest pain: 2.54 Preinfarction angina: 9.70 Vascular disease: 0.40 Duration of CAD: 9.16 Congestive heart failure: 0.59 Hypertension: 5.19 Family history: 6.39 Ventricular gallop: 1.06 Cardiomegaly: 1.41

Electrocardiographic premature ventricular contractions: 0.46

The results from the training group are shown under “Clinically Important Characteristics and the Chi-squared” in the order of their importance (chi-squared added to the model by the parameter, adjusting for the characteristics that precede it). The type of chest pain (typical, atypical or nonanginal) was the most important characteristic followed by previous MI, sex, age, smoking, hyperlipidaemia, ST-T wave changes on ECG, diabetes. The results above show the 4 significant interactions which were found.
The study also showed that in men the effect of an increasing age was more important than in women, smoking was more important for women than men, and that smoking and hyperlipidaemia were more important at younger ages. The results for the other characteristics which were found to have small or nonsignificat effects on the prevalence of disease are shown under “Poor Clinical Predictors of Significant CAD and the Chi-squared”

The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence. This was with the exception of the group with predicted estimates of 0.475 to 0.525 (this group 8 out of 34 patients, with significant disease). The median prediction for patients with disease was 94% compared with a median prediction of 33% for patients without disease. A predicted probability of significant disease > 0.83 was found in 75% of patients with disease and in less than 10% of patients with disease. A probability of significant disease < 0.33 was found in nearly 50% of patients without disease and in less than 5% of patients with disease.

The authors then externally validated using the population from the CASS study. There was disagreement on patients classified as having nonanginal chest pain (where the greatest difference in predicted disease compared to observed disease was seen), but the predicted estimates from the model were nearly equal to the observed prevalence of disease. The predicted estimates from the model of the probability of significant disease were nearly identical to the observed prevalence for subgroups based on “age, sex and history of MI” or “age, sex and pain type”.

Safety and adverse effects

None

Does the study answer the question?

Progressive chest pain was described as being chest pain when the frequency, severity or duration had increased in the 6 weeks prior to catherisation. Preinfarctional chest pain was described as chest pain with a very unstable pain pattern that resulted in admission to the coronary care unit for evaluation of the possible MI

The results from the training population showed the type of chest pain (typical, atypical or nonanginal) was the most important characteristic followed by previous MI, sex, age, smoking, hyperlipidaemia, ST-T wave changes on ECG, diabetes. The study also showed that in men the effect of an increasing age was more important than in women, smoking was more important for women than men, and that smoking and hyperlipidaemia were more important at younger ages. The study also found some characteristics to have small or nonsignificat effects on the prevalence of disease.

The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence. When comparing the model to an external population the study showed that the predicted estimates from the model were nearly equal to the observed prevalence of disease. The predicted estimates from the model of the probability of significant disease were nearly identical to the observed prevalence for subgroups based on “age, sex and history of MI” or “age, sex and pain type”. However the greatest difference in predicted disease compared to observed disease was seen in patients with nonanginal chest pain.

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?	Patients had chest pain
Internal Validity	Well covered

Pryor DB;Harrell FE;Lee KL;Califf RM;Rosati RA;

Estimating the likelihood of significant coronary artery disease

Ref ID 10283 The American journal of medicine pgs: 771 to 780 1983

Study Type Cohort **Funding** Not reported

Number of participant	3627 in training population, 1811 in test population
Inclusion/Exclusion Criteria	Patients with chest pain who were referred for cardiac catheterization at the Duke University Medical Center between November 1969 and January 1982
Patient Characteristics	Patient characteristics which were collected were: History: age, sex, chest pain history (pain type, severity, frequency, nocturnal, progressive, preinfarctional), duration of CAD, previous history of MI, congestive heart failure, history of vascular disease (Progressive chest pain - the frequency, severity or duration had increased in the 6 weeks prior to catherisation; Preinfarctional chest pain - a very unstable pain pattern that resulted in admission to the coronary care unit for evaluation of the possible MI) Risk factors: smoking, hyperlipidaemia, hypertension, diabetes, family history Physical examination: ventricular gallop, systolic blood pressure ECG: ST-T wave changes, electrocardiographic premature ventricular contractions, Electrocardiographic Q waves Chest X-Ray: cardiomegaly
Recruitment	Patients admitted for cardiac catheterisation between 1969 and 1982
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Chest pain diagnosis
Comparisons	Patient characteristics which give a probability of disease
Length of Study/ Follow-up	
Outcome measures studied	Probability of disease
Results	The study had a training population of 3627 patients who were seen between 1969 and January 1979, from these patients a stepwise logistic regression analysis was used to develop a model for predicting the probability of significant CAD. A test population of 1811 patients seen between January 1969 and January 1982, in this population the model developed in the test population was used to predict the probability of CAD for each patient. The authors then tested the model in other populations (from CASS study) to estimate the prevalence of disease in subgroups of the patients in the literature (external validation) Results from training population: See narrative for question 27; Table 6: Pryor et al, 1983 Clinically Important Characteristics and the Chi-squared: Pain type (typical, atypical or nonanginal): 1091 Previous MI: 511 Sex: 187 Age: 119

Smoking: 79
Hyperlipidaemia: 26
ST-T wave changes: 28
Diabetes: 12

Interactions
age X sex
age X smoking
age X hyperlipidaemia
sex X smoking

Poor Clinical Predictors of Significant CAD and the Chi-squared: See narrative for question 27; Table 7: Pryor et al, 1983
Chest pain severity: 0.96
Chest pain frequency: 8.57
Nocturnal chest pain: 2.22
Progressive chest pain: 2.54
Preinfarction angina: 9.70
Vascular disease: 0.40
Duration of CAD: 9.16
Congestive heart failure: 0.59
Hypertension: 5.19
Family history: 6.39
Ventricular gallop: 1.06
Cardiomegaly: 1.41
Electrocardiographic premature ventricular contractions: 0.46

The results from the training group are shown under “Clinically Important Characteristics and the Chi-squared” in the order of their importance (chi-squared added to the model by the parameter, adjusting for the characteristics that precede it). The type of chest pain (typical, atypical or nonanginal) was the most important characteristic followed by previous MI, sex, age, smoking, hyperlipidaemia, ST-T wave changes on ECG, diabetes. The results above show the 4 significant interactions which were found.
The study also showed that in men the effect of an increasing age was more important than in women, smoking was more important for women than men, and that smoking and hyperlipidaemia were more important at younger ages. The results for the other characteristics which were found to have small or nonsignificat effects on the prevalence of disease are shown under “Poor Clinical Predictors of Significant CAD and the Chi-squared”

The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence. This was with the exception of the group with predicted estimates of 0.475 to 0.525 (this group 8 out of 34 patients, with significant disease). The median prediction for patients with disease was 94% compared with a median prediction of 33% for patients without disease. A predicted probability of significant disease > 0.83 was found in 75% of patients with disease and in less than 10% of patients with disease. A probability of significant disease < 0.33 was found in nearly 50% of patients without disease and in less than 5% of patients with disease.

The authors then externally validated using the population from the CASS study. There was disagreement on patients classified as having nonanginal chest pain (where the greatest difference in predicted disease compared to observed disease was seen), but the predicted estimates from the model were nearly equal to the observed prevalence of disease. The predicted estimates from the model of the probability of significant disease were nearly identical to the observed prevalence for subgroups based on “age, sex and history of MI” or “age, sex and pain type”.

Safety and adverse effects

None

Does the study answer the question?

The results from the training population showed the type of chest pain (typical, atypical or nonanginal) was the most important characteristic followed by previous MI, sex, age, smoking, hyperlipidaemia, ST-T wave changes on ECG, diabetes. The study also showed that in men the effect of an increasing age was more important than in women, smoking was more important for women than men, and that smoking and hyperlipidaemia were more important at younger ages. The study also found some characteristics to have small or nonsignificat effects on the prevalence of disease.

	The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence. When comparing the model to an external population the study showed that the predicted estimates from the model were nearly equal to the observed prevalence of disease. The predicted estimates from the model of the probability of significant disease were nearly identical to the observed prevalence for subgroups based on “age, sex and history of MI” or “age, sex and pain type”. However the greatest difference in predicted disease compared to observed disease was seen in patients with nonanginal chest pain.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Patients had chest pain
Internal Validity	Well covered

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Pryor DB;Shaw L;McCants CB;Lee KL;Mark DB;Harrell FE;Muhlbaier LH;Califf RM;

Value of the history and physical in identifying patients at increased risk for coronary artery disease

Ref ID 1751 Annals of internal medicine pgs: 81 to 90 1993

Study Type Cohort

Funding Agency for Health Care Policy and Research, National Heart, Lung and Blood institute, National Library of Medicine

Number of participant	1030 patients, 168 had cardiac catheterization
Inclusion/Exclusion Criteria	Inclusion: Symptomatic patients, referred for non-invasive testing for suspected coronary artery disease Exclusion: previous cardiac catheterization
Patient Characteristics	The mean age was 55, 37% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 12 months, 28% had typical angina symptoms, 52% atypical angina symptoms, 20% nonanginal pain, 18% progressive angina, 22% nocturnal angina, 44% smoked, 41% had a history of hypertension, 10% had diabetes, 11% had hyperlipidemia, 35% had ST-T wave changes on ECG, 18% had a history of MI, 8% had Q waves on ECG, 14% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 3% had peripheral vascular disease, 3% had cerebral vascular disease Of the patients who went on to have a cardiac catheterization the mean age was 56, 31% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 7 months, 49% had typical angina symptoms, 47% atypical angina symptoms, 4% nonanginal pain, 24% progressive angina, 24% nocturnal angina, 53% smoked, 42% had a history of hypertension, 10% had diabetes, 13% had hyperlipidemia, 42% had ST-T wave changes on ECG, 33% had a history of MI, 11% had Q waves on ECG, 11% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 4% had peripheral vascular disease, 2% had cerebral vascular disease. It can therefore be seen that those having a cardiac catheterization were more likely to be male, smoke, have a history of MI, have ST-T wave changes on ECG and to be suffering typical or progressive angina
Recruitment	Patients were referred for non-invasive testing for suspected coronary artery disease
Setting	Duke University Medical Centre USA
Interventions/ Test/ Factor being investigated	Physicians initial evaluation of patients with suspected CAD predicts coronary anatomy
Comparisons	The presence of significant coronary disease defined as any disease, severe disease, left main disease
Length of Study/ Follow-up	90 days
Outcome measures studied	Effectiveness of chest pain score to predict coronary artery disease
Results	The three diagnostic outcomes were; the presence of significant coronary artery disease defined as ‘any disease’ (≥ 75% luminal diameter narrowing of at least one major coronary artery), presence of severe coronary artery disease defined as ‘severe disease’ (significant obstruction of all 3 main coronary arteries or the left main coronary artery) and the presence of significant left main artery obstruction defined as ‘left main disease’ (168 patients referred for cardiac catheterization). The

prognostic outcome was survival at 3 years.
In the multivariable regression model used, the following variables were significant predictors for any disease; age, gender, chest pain (type), diabetes, smoking, hyperlipidaemia, previous history of myocardial infarction, and significant Q waves and ST-T wave changes. For severe disease, the following variables were significant predictors; age, gender, chest pain (type, frequency, course, nocturnal, length of time present), diabetes, smoking, hyperlipidaemia, hypertension, peripheral or cerebral artery disease, carotid bruit, previous history of myocardial infarction, and significant Q waves and ST-T wave changes. For left main disease, the following variables were significant predictors; age, gender, chest pain (type), diabetes, peripheral or cerebral artery disease and carotid bruit. For survival at 3 years the following variables were significant predictors; age, gender, chest pain (frequency, course, nocturnal), peripheral or cerebral artery disease, carotid bruit, ventricular gallop, previous history of myocardial infarction, significant Q waves and ST-T wave changes, conduction abnormalities, premature ventricular contractions and cardiomegaly. The likelihood of any disease, severe coronary disease, left main disease and survival was predicted from the initial history, physical examination, electrocardiogram and chest X ray (these tests were defined as the 'initial evaluation'). The models which were used were based on mathematical models in a previous study (Pryor, 1983 – see extraction).
Predicted coronary artery endpoints and survival based on the initial evaluation closely corresponded to actual findings. Predictions using the initial evaluation were then compared with predictions based on the treadmill exercise test. The initial evaluation was slightly better at distinguishing patients with and without coronary artery disease compared with the treadmill exercise test. The initial evaluation and the treadmill exercise test had similar discriminatory performances for patients with and without severe disease and risk of death at 3 years, while for left main disease, the treadmill exercise test was slightly better for identify patients with left main disease.

Safety and adverse effects

None reported

Does the study answer the question?

In the multivariable regression model used, the following variables were significant predictors for any disease; age, gender, chest pain (type), diabetes, smoking, hyperlipidaemia, previous history of MI, and significant Q waves and ST-T wave changes. For severe disease, the following variables were significant predictors; age, gender, chest pain (type, frequency, course, nocturnal, length of time present), diabetes, smoking, hyperlipidaemia, hypertension, peripheral or cerebral artery disease, carotid bruit, previous history of MI, and significant Q waves and ST-T wave changes. For left main disease, the following variables were significant predictors; age, gender, chest pain (type), diabetes, peripheral or cerebral artery disease and carotid bruit. For survival at 3 years the following variables were significant predictors; age, gender, chest pain (frequency, course, nocturnal, peripheral or cerebral artery disease, carotid bruit, ventricular gallop, previous history of MI, significant Q waves and ST-T wave changes, conduction abnormalities, premature ventricular contractions and cardiomegaly. The likelihood of any disease, severe coronary disease, left main disease and survival was predicted from the initial history, physical examination, electrocardiogram and chest X ray (these tests were defined as the 'initial evaluation').

Predicted coronary artery endpoints and survival based on the initial evaluation closely corresponded to actual findings. Predictions using the initial evaluation were then compared with predictions based on the treadmill exercise test. The initial evaluation was slightly better at distinguishing patients with and without coronary artery disease compared with the treadmill exercise test. The initial evaluation and the treadmill exercise test had similar discriminatory performances for patients with and without severe disease and risk of death at 3 years, while for left main disease, while the treadmill exercise test was slightly better for identify patients with left main disease. The models which were used were based on mathematical models in a previous study (Pryor, 1983 – see extraction).

During the study a chest X-ray was also performed, the results did not help in predicting coronary disease, however they could be used to predict survival.

Effect due to factor in study?

Yes

Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Pryor DB;Shaw L;McCants CB;Lee KL;Mark DB;Harrell FE;Muhlbaier LH;Califf RM;

Value of the history and physical in identifying patients at increased risk for coronary artery disease

Ref ID 1751 Annals of internal medicine pgs: 81 to 90 1993

Study Type	Cohort	**Funding**	Agency for Health Care Policy and Research, National Heart, Lung and Blood institute, National Library of Medicine

Number of participant	1030 patients, 168 had cardiac catheterization
Inclusion/Exclusion Criteria	Inclusion: Symptomatic patients, referred for non-invasive testing for suspected coronary artery disease Exclusion: previous cardiac catheterization
Patient Characteristics	The mean age was 55, 37% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 12 months, 28% had typical angina symptoms, 52% atypical angina symptoms, 20% nonanginal pain, 18% progressive angina, 22% nocturnal angina, 44% smoked, 41% had a history of hypertension, 10% had diabetes, 11% had hyperlipidemia, 35% had ST-T wave changes on ECG, 18% had a history of MI, 8% had Q waves on ECG, 14% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 3% had peripheral vascular disease, 3% had cerebral vascular disease Of the patients who went on to have a cardiac catheterization the mean age was 56, 31% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 7 months, 49% had typical angina symptoms, 47% atypical angina symptoms, 4% nonanginal pain, 24% progressive angina, 24% nocturnal angina, 53% smoked, 42% had a history of hypertension, 10% had diabetes, 13% had hyperlipidemia, 42% had ST-T wave changes on ECG, 33% had a history of MI, 11% had Q waves on ECG, 11% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 4% had peripheral vascular disease, 2% had cerebral vascular disease. It can therefore be seen that those having a cardiac catheterization were more likely to be male, smoke, have a history of MI, have ST-T wave changes on ECG and to be suffering typical or progressive angina
Recruitment	Patients were referred for non-invasive testing for suspected coronary artery disease
Setting	Duke University Medical Centre USA
Interventions/ Test/ Factor being investigated	Physicians initial evaluation of patients with suspected CAD predicts coronary anatomy
Comparisons	The presence of significant coronary disease defined as any disease, severe disease, left main disease
Length of Study/ Follow-up	90 days
Outcome measures studied	Effectiveness of chest pain score to predict coronary artery disease

Results

The three diagnostic outcomes were; the presence of significant coronary artery disease defined as 'any disease' (≥ 75% luminal diameter narrowing of at least one major coronary artery), presence of severe coronary artery disease defined as 'severe disease' (significant obstruction of all 3 main coronary arteries or the left main coronary artery) and the presence of significant left main artery obstruction defined as 'left main disease' (168 patients referred for cardiac catheterization). The prognostic outcome was survival at 3 years.

In the multivariable regression model used, the following variables were significant predictors for any disease; age, gender, chest pain (type), diabetes, smoking, hyperlipidaemia, previous history of myocardial infarction, and significant Q waves and ST-T wave changes. For severe disease, the following variables were significant predictors; age, gender, chest pain (type, frequency, course, nocturnal, length of time present), diabetes, smoking, hyperlipidaemia, hypertension, peripheral or cerebral artery disease, carotid bruit, previous history of myocardial infarction, and significant Q waves and ST-T wave changes. For left main disease, the following variables were significant predictors; age, gender, chest pain (type), diabetes, peripheral or cerebral artery disease and carotid bruit. For survival at 3 years the following variables were significant predictors; age, gender, chest pain (frequency, course, nocturnal), peripheral or cerebral artery disease, carotid bruit, ventricular gallop, previous history of myocardial infarction, significant Q waves and ST-T wave changes, conduction abnormalities, premature ventricular contractions and cardiomegaly. The likelihood of any disease, severe coronary disease, left main disease and survival was predicted from the initial history, physical examination, electrocardiogram and chest X ray (these tests were defined as the 'initial evaluation'). The models which were used were based on mathematical models in a previous study (Pryor, 1983 – see extraction).

Predicted coronary artery endpoints and survival based on the initial evaluation closely corresponded to actual findings. Predictions using the initial evaluation were then compared with predictions based on the treadmill exercise test. The initial evaluation was slightly better at distinguishing patients with and without coronary artery disease compared with the treadmill exercise test. The initial evaluation and the treadmill exercise test had similar discriminatory performances for patients with and without severe disease and risk of death at 3 years, while for left main disease, the treadmill exercise test was slightly better for identify patients with left main disease.

Safety and adverse effects

None reported

Does the study answer the question?

In the multivariable regression model used, the following variables were significant predictors for any disease; age, gender, chest pain (type), diabetes, smoking, hyperlipidaemia, previous history of MI, and significant Q waves and ST-T wave changes. For severe disease, the following variables were significant predictors; age, gender, chest pain (type, frequency, course, nocturnal, length of time present), diabetes, smoking, hyperlipidaemia, hypertension, peripheral or cerebral artery disease, carotid bruit, previous history of MI, and significant Q waves and ST-T wave changes. For left main disease, the following variables were significant predictors; age, gender, chest pain (type), diabetes, peripheral or cerebral artery disease and carotid bruit. For survival at 3 years the following variables were significant predictors; age, gender, chest pain (frequency, course, nocturnal, peripheral or cerebral artery disease, carotid bruit, ventricular gallop, previous history of MI, significant Q waves and ST-T wave changes, conduction abnormalities, premature ventricular contractions and cardiomegaly. The likelihood of any disease, severe coronary disease, left main disease and survival was predicted from the initial history, physical examination, electrocardiogram and chest X ray (these tests were defined as the 'initial evaluation').

Predicted coronary artery endpoints and survival based on the initial evaluation closely corresponded to actual findings. Predictions using the initial evaluation were then compared with predictions based on the treadmill exercise test. The initial evaluation was slightly better at distinguishing patients with and without coronary artery disease compared with the treadmill exercise test. The initial evaluation and the treadmill exercise test had similar discriminatory performances for patients with and without severe disease and risk of death at 3 years, while for left main disease, while the treadmill exercise test was slightly better for identify patients with left main disease. The models which were used were based on mathematical models in a previous study (Pryor, 1983 – see extraction).

During the study a chest X-ray was also performed, the results did not help in predicting coronary disease, however they could be used to predict survival.

Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Sox HC;Hickam DH;Marton K;Moses L;Skeff KM;Sox CH;Neal EA;

Using the patient's history to estimate the probability of coronary artery disease: a comparison of primary care and referral practices

Ref ID 1895 The American journal of medicine pgs: 7 to 14 1990

Study Type Cohort

Funding Veterans Administration Health Services Research and Development Service, Henry J. Kaiser Family Foundation and Henry J. Kaiser Family Foundation General Internal Medicine Fellowship Program

Number of participant	1074 patients
Inclusion/Exclusion Criteria	Inclusion: had at least 2 episodes of chest pain that led to the index visit. Exclusion: patients whose index visit led to a diagnosis of acute MI were excluded
Patient Characteristics	
Recruitment	Patients admitted to Stanford University Medical Centre, or seen at Palo Alto VA Medical Center and Kaiser-Permanente Medical Center, Santa Medical Centre, USA
Setting	Primary and Secondary care USA
Interventions/ Test/ Factor being investigated	Diagnosing coronary artery disease
Comparisons	Age, men, pain brought on by exertion, having to stop all activities when pain occurs, history of MI, pain relieved within 3 minutes of taking nitroglycerin, and ≥ 20 pack years of smoking
Length of Study/ Follow-up	Median follow up 11 months
Outcome measures studied	Effectiveness of chest pain score to predict coronary artery disease
Results	Seven clinical characteristics were identified as independent predictors of significant coronary stenosis; age > 60 years, pain brought on by exertion, patient having to stop all activities when pain occurs, history of myocardial infarction, pain relieved within 3 minutes of taking nitroglycerin, at least 20 pack years of smoking, and male gender. The following were not independent predictors of disease status; location and radiation of pain, character of pain, history of hypertension, history of hypercholesterolaemia, history of angina pectoris, pain worsened by cough, deep breathing, movement of torso, or movement of arm. The chest pain score was used to test the probability of coronary artery disease (CAD) in patients from two primary care practices (997 patients) and one angiography referral practice (166 patients). Distribution of patients among Chest Pain Score Subgroups: See narrative for

question 27; Table 9: Sox et al, 1990
1980 Arteriography Training Set:
Score 0-4: 1 had significant CAD, 9 had insignificant CAD and the prevalence of CAD was 0.10
Score 5-9: 13 had significant CAD, 20 had insignificant CAD and the prevalence of CAD was 0.39
Score 10-14: 33 had significant CAD, 16 had insignificant CAD and the prevalence of CAD was 0.67
Score 15-19: 77 had significant CAD, 8 had insignificant CAD and the prevalence of CAD was 0.91
Score 20-25: 34 had significant CAD, 0 had insignificant CAD and the prevalence of CAD was 1.00
The total number of patients was: 158 with significant CAD, 53 had insignificant CAD and the prevalence of CAD was 0.76

1982 Arteriography Test Set:
Score 0-4: 1 had significant CAD, 6 had insignificant CAD and the prevalence of CAD was 0.14
Score 5-9: 4 had significant CAD, 13 had insignificant CAD and the prevalence of CAD was 0.24
Score 10-14: 31 had significant CAD, 13 had insignificant CAD and the prevalence of CAD was 0.70
Score 15-19: 49 had significant CAD, 10 had insignificant CAD and the prevalence of CAD was 0.83
Score 20-25: 37 had significant CAD, 6 had insignificant CAD and the prevalence of CAD was 0.86
The total number of patients was: 122 with significant CAD, 48 had insignificant CAD and the prevalence of CAD was 0.72

VA Test Set:
Score 0-4: 0 had significant CAD, 4 had insignificant CAD and the prevalence of CAD was 0.00
Score 5-9: 9 had significant CAD, 139 had insignificant CAD and the prevalence of CAD was 0.06
Score 10-14: 27 had significant CAD, 99 had insignificant CAD and the prevalence of CAD was 0.21
Score 15-19: 64 had significant CAD, 26 had insignificant CAD and the prevalence of CAD was 0.71
Score 20-25: 33 had significant CAD, 3 had insignificant CAD and the prevalence of CAD was 0.92
The total number of patients was: 133 with significant CAD, 271 had insignificant CAD and the prevalence of CAD was 0.33

Kaiser Test Set:
Score 0-4: 0 had significant CAD, 98 had insignificant CAD and the prevalence of CAD was 0.00
Score 5-9: 7 had significant CAD, 118 had insignificant CAD and the prevalence of CAD was 0.06
Score 10-14: 4 had significant CAD, 35 had insignificant CAD and the prevalence of CAD was 0.10
Score 15-19: 6 had significant CAD, 14 had insignificant CAD and the prevalence of CAD was 0.30
Score 20-25: 6 had significant CAD, 1 had insignificant CAD and the prevalence of CAD was 0.86
The total number of patients was: 23 with significant CAD, 266 had insignificant CAD and the prevalence of CAD was 0.08

The prevalence of a coronary artery disease diagnosis in primary care patients is lower than in arteriography patients with similar chest pain histories. With the exception of the highest chest pain score subgroup, analysis on the two primary care population's show there is not perfect agreement.

Although the patients in the primary and secondary settings had similar chest pain scores derived from the clinical history, the prevalence of coronary artery disease in the primary care patients was lower than the angiography patients across the first four scores bands compared with the angiography patients, while the prevalence at the highest score band was similar in both the primary and secondary settings.

The authors concluded that health care professionals should take in to account the

	clinical setting when using the patient's history to estimate the probability of disease
Safety and adverse effects	None reported
Does the study answer the question?	The chest pain score was used to test the probability of coronary artery disease in patients from two primary care practices (997 patients) and one angiography referral practice (166 patients). Although the patients in the primary and secondary settings had similar chest pain scores derived from the clinical history, the prevalence of coronary artery disease in the primary care patients was lower than the angiography patients across the first four scores bands compared with the angiography patients, while the prevalence at the highest score band was similar in both the primary and secondary settings. The authors concluded that health care professionals should take in to account the clinical setting when using the patient's history to estimate the probability of disease
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Sox HC;Hickam DH;Marton K;Moses L;Skeff KM;Sox CH;Neal EA;

Using the patient's history to estimate the probability of coronary artery disease: a comparison of primary care and referral practices

Ref ID 1895 The American journal of medicine pgs: 7 to 14 1990

Study Type	Cohort	**Funding**	Veterans Administration Health Services Research and Development Service, Henry J. Kaiser Family Foundation and Henry J. Kaiser Family Foundation General Internal Medicine Fellowship Program

Number of participant	1074 patients
Inclusion/Exclusion Criteria	Inclusion: had at least 2 episodes of chest pain that led to the index visit. Exclusion: patients whose index visit led to a diagnosis of acute MI were excluded
Patient Characteristics	
Recruitment	Patients admitted to Stanford University Medical Centre, or seen at Palo Alto VA Medical Center and Kaiser-Permanente Medical Center, Santa Medical Centre, USA
Setting	Primary and Secondary care USA
Interventions/ Test/ Factor being investigated	Diagnosing coronary artery disease
Comparisons	Age, men, pain brought on by exertion, having to stop all activities when pain occurs, history of MI, pain relieved within 3 minutes of taking nitroglycerin, and ≥ 20 pack years of smoking
Length of Study/ Follow-up	Median follow up 11 months

Outcome measures studied

Effectiveness of chest pain score to predict coronary artery disease

Results

Seven clinical characteristics were identified as independent predictors of significant coronary stenosis; age > 60 years, pain brought on by exertion, patient having to stop all activities when pain occurs, history of myocardial infarction, pain relieved within 3 minutes of taking nitroglycerin, at least 20 pack years of smoking, and male gender. The following were not independent predictors of disease status; location and radiation of pain, character of pain, history of hypertension, history of hypercholesterolaemia, history of angina pectoris, pain worsened by cough, deep breathing, movement of torso, or movement of arm. The chest pain score was used to test the probability of coronary artery disease (CAD) in patients from two primary care practices (997 patients) and one angiography referral practice (166 patients).

Distribution of patients among Chest Pain Score Subgroups: See narrative for question 26; Table 8: Sox et al, 1990
1980 Arteriography Training Set:
Score 0-4: 1 had significant CAD, 9 had insignificant CAD and the prevalence of CAD was 0.10
Score 5-9: 13 had significant CAD, 20 had insignificant CAD and the prevalence of CAD was 0.39
Score 10-14: 33 had significant CAD, 16 had insignificant CAD and the prevalence of CAD was 0.67
Score 15-19: 77 had significant CAD, 8 had insignificant CAD and the prevalence of CAD was 0.91
Score 20-25: 34 had significant CAD, 0 had insignificant CAD and the prevalence of CAD was 1.00
The total number of patients was: 158 with significant CAD, 53 had insignificant CAD and the prevalence of CAD was 0.76

1982 Arteriography Test Set:
Score 0-4: 1 had significant CAD, 6 had insignificant CAD and the prevalence of CAD was 0.14
Score 5-9: 4 had significant CAD, 13 had insignificant CAD and the prevalence of CAD was 0.24
Score 10-14: 31 had significant CAD, 13 had insignificant CAD and the prevalence of CAD was 0.70
Score 15-19: 49 had significant CAD, 10 had insignificant CAD and the prevalence of CAD was 0.83
Score 20-25: 37 had significant CAD, 6 had insignificant CAD and the prevalence of CAD was 0.86
The total number of patients was: 122 with significant CAD, 48 had insignificant CAD and the prevalence of CAD was 0.72

VA Test Set:
Score 0-4: 0 had significant CAD, 4 had insignificant CAD and the prevalence of CAD was 0.00
Score 5-9: 9 had significant CAD, 139 had insignificant CAD and the prevalence of CAD was 0.06
Score 10-14: 27 had significant CAD, 99 had insignificant CAD and the prevalence of CAD was 0.21
Score 15-19: 64 had significant CAD, 26 had insignificant CAD and the prevalence of CAD was 0.71
Score 20-25: 33 had significant CAD, 3 had insignificant CAD and the prevalence of CAD was 0.92
The total number of patients was: 133 with significant CAD, 271 had insignificant CAD and the prevalence of CAD was 0.33

Kaiser Test Set:
Score 0-4: 0 had significant CAD, 98 had insignificant CAD and the prevalence of CAD was 0.00
Score 5-9: 7 had significant CAD, 118 had insignificant CAD and the prevalence of CAD was 0.06
Score 10-14: 4 had significant CAD, 35 had insignificant CAD and the prevalence of CAD was 0.10
Score 15-19: 6 had significant CAD, 14 had insignificant CAD and the prevalence of CAD was 0.30
Score 20-25: 6 had significant CAD, 1 had insignificant CAD and the prevalence of CAD was 0.86

The total number of patients was: 23 with significant CAD, 266 had insignificant CAD and the prevalence of CAD was 0.08

The prevalence of a coronary artery disease diagnosis in primary care patients is lower than in arteriography patients with similar chest pain histories. With the exception of the highest chest pain score subgroup, analysis on the two primary care population's show there is not perfect agreement.

Although the patients in the primary and secondary settings had similar chest pain scores derived from the clinical history, the prevalence of coronary artery disease in the primary care patients was lower than the angiography patients across the first four scores bands compared with the angiography patients, while the prevalence at the highest score band was similar in both the primary and secondary settings.

The authors concluded that health care professionals should take in to account the clinical setting when using the patient's history to estimate the probability of disease

Safety and adverse effects None reported

Does the study answer the question? The chest pain score was used to test the probability of coronary artery disease in patients from two primary care practices (997 patients) and one angiography referral practice (166 patients). Although the patients in the primary and secondary settings had similar chest pain scores derived from the clinical history, the prevalence of coronary artery disease in the primary care patients was lower than the angiography patients across the first four scores bands compared with the angiography patients, while the prevalence at the highest score band was similar in both the primary and secondary settings. The authors concluded that health care professionals should take in to account the clinical setting when using the patient's history to estimate the probability of disease

Effect due to factor in study? Yes

Consistency of results with other studies? Consistent

Directly applicable to guideline population? Correct population

Internal Validity Well covered

Wu EB;Hodson F;Chambers JB;

A simple score for predicting coronary artery disease in patients with chest pain

Ref ID	394	QJM : monthly journal of the Association of Physicians	pgs:	803	to	811	2005

Study Type Cohort

Funding Grant from the special Trustee's of Guy's and St Thomas' NHS trust

Number of participant 404 patients recruited from 363 consecutive patients seen as out-patients, and 829 consecutive patients undergoing day-case coronary angiography. 155 of the 404 had an exercise test

Inclusion/Exclusion Criteria Inclusion: chest pain for > 1 month without a previous history of MI, coronary angiography, angioplasty or coronary artery bypass grafting
Exclusion: ECG showed pathological Q waves or regional wall motion abnormalities on echocardiogram

Patient Characteristics The mean age was 60.6±9.5 years. 66% (268) were males, the mean age for males 60.5±9.1 years; 34% (137) were females, the mean ages for females was 60.8±10.2 years. Of all the patients 60% (244) had significant coronary artery disease; 40% (161) had normal coronary anatomy

Recruitment Patients who met criteria recruited from out patients at Cardiothoracic Centre, Guy's and St Thomas' Hospital, London, UK

Setting	Guy's and St Thomas' Hospital, London, UK
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score was based on: description of pain, clinical history, medication, clinical examination, stigmata of risk, resting ECG
Length of Study/ Follow-up	Not reported
Outcome measures studied	Diagnosis of coronary artery disease, or exclusion of diagnosis of coronary artery disease
Results	The chest pain score was based on the following: localisation of pain, radiation, quality of pain, duration, length of pain episode, frequency, associated features (breathlessness, digital paraesthesiae, palpation, light-headedness), precipitation (exercise, rest, any time, neck or back movement, carrying, swallowing, lying flat/stooping, emotional stress, particular situations), exacerbating / relieving factors (inspiration, GNT, genuine relief < 5 minutes) relief with (milk/antacids, belching, local massage rest). A medical history was also taken of: hypertension, hypercholesterolemia, diabetes, smoking and number of cigarettes per day, previous MI, alcohol intake per week, medication being used (aspirin, statins, beta blockers, calcium antagonists, nitrates, other), the patients weight, height, heart rhythm, systolic, diastolic, heart rate, apex position and character, intercostal space, heart murmur, heart sounds stigmata of risk (arcus, xanthelasmata, xanthomata, ear lobe crease) and a resting ECG. This chest pain score was based on a modification of the Master Questionnaire with 3 additional questions to define the exercise score, the rest and duration score. 1) if you go up a hill on 10 separate occasions how many do you experience chest pain; 2) if you have chest pain 10 times in a row how many happen when you are sitting or resting; 3) how long does the pain last for. For question 1 10/10 was described as “typical” and 1-9/10 was “atypical”; for question 2 a rest index or 0 or 1 was “typical and 2 or more was “atypical”; for question 3 pain lasting less than 5 minutes was “typical” and pain last more than 5 minutes was “atypical” Multivariant Poisson Regression Analysis, (see narrative for question 26; Table 7: Wu et al, 2005) showed that gender (P < 0.001), age (P < 001), relief with rest (P=0.046), dizziness (P=0.030), smoking (P=0.006), hypertension (P=0.016), hypercholesterolemia (P=0.214), diabetes (P=0.016) and chest pain score (P = 0.009) were independently differentiated those patients with and without CAD. A secondary analysis was conducted to relate the chest pain score to the Framingham and Duke Scores. The Duke Score is a weighted index based on ST-segment deviation, treadmill time and exercised-induced angina (Duke Treadmill Score = Exercise time – [5xSTdevistion] – [4xtreadmill angina]). The chest pain score was found to have a sensitivity of 91.4% and a specificity of 28%, compared to the Duke score’s sensitivity of 82.4% and specificity of 31%. The study found that the combination of the chest pain score with Framingham and the Duke score had additive predictive value for risk of coronary artery disease.
Safety and adverse effects	None reported
Does the study answer the question?	Multivariant Poisson regression analysis showed that gender (P < 0.001), age (P < 001), relief with rest (P=0.046), dizziness (P=0.030), smoking (P=0.006), hypertension (P=0.016), hypercholesterolemia (P=0.214), diabetes (P=0.016) and chest pain score were (P = 0.009) independently differentiated those patients with and without coronary artery disease. A secondary analysis was conducted to relate the chest pain score to the Framingham and Duke scores. The chest pain score was found to have a sensitivity of 91.4% and a specificity of 28%, compared to the Duke score’s sensitivity of 82.4% and specificity of 31%. The study found that the combination of the chest pain score with Framingham and the Duke score had additive predictive value for risk of coronary artery disease
Effect due to factor in study?	Yes

Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Wu EB;Hodson F;Chambers JB;

A simple score for predicting coronary artery disease in patients with chest pain

Ref ID 394 | QJM : monthly journal of the Association of Physicians | pgs: 803 to 811 | 2005

Study Type Cohort

Funding Grant from the special Trustee's of Guy's and St Thomas' NHS trust

Number of participant	404 patients recruited from 363 consecutive patients seen as out-patients, and 829 consecutive patients undergoing day-case coronary angiography. 155 of the 404 had an exercise test
Inclusion/Exclusion Criteria	Inclusion: chest pain for > 1 month without a previous history of MI, coronary angiography, angioplasty or coronary artery bypass grafting Exclusion: ECG showed pathological Q waves or regional wall motion abnormalities on echocardiogram
Patient Characteristics	The mean age was 60.6±9.5 years. 66% (268) were males, the mean age for males 60.5±9.1 years; 34% (137) were females, the mean ages for females was 60.8±10.2 years. Of all the patients 60% (244) had significant coronary artery disease; 40% (161) had normal coronary anatomy
Recruitment	Patients who met criteria recruited from out patients at Cardiothoracic Centre, Guy's and St Thomas' Hospital, London, UK
Setting	Guy's and St Thomas' Hospital, London, UK
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score was based on: description of pain, clinical history, medication, clinical examination, stigmata of risk, resting ECG
Length of Study/ Follow-up	Not reported
Outcome measures studied	Diagnosis of coronary artery disease, or exclusion of diagnosis of coronary artery disease
Results	The chest pain score was based on the following: localisation of pain, radiation, quality of pain, duration, length of pain episode, frequency, associated features (breathlessness, digital paraesthesiae, palpation, light-headedness), precipitation (exercise, rest, any time, neck or back movement, carrying, swallowing, lying flat/stooping, emotional stress, particular situations), exacerbating / relieving factors (inspiration, GNT, genuine relief < 5 minutes) relief with (milk/antacids, belching, local massage rest). A medical history was also taken of: hypertension, hypercholesterolemia, diabetes, smoking and number of cigarettes per day, previous MI, alcohol intake per week, medication being used (aspirin, statins, beta blockers, calcium antagonists, nitrates, other), the patients weight, height, heart rhythm, systolic, diastolic, heart rate, apex position and character, intercostal space, heart murmur, heart sounds stigmata of risk (arcus, xanthelasmata, xanthomata, ear lobe crease) and a resting ECG. This chest pain score was based on a modification of the Master Questionnaire with 3 additional questions to define the exercise score, the rest and duration score. 1) if you go up a hill on 10 separate occasions how many do you experience chest pain; 2) if you have chest pain 10 times in a row how many happen when you are

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Safety and adverse effects	None reported
Does the study answer the question?	Multivariant Poisson regression analysis showed that gender (P < 0.001), age (P < 001), relief with rest (P=0.046), dizziness (P=0.030), smoking (P=0.006), hypertension (P=0.016), hypercholesterolemia (P=0.214), diabetes (P=0.016) and chest pain score were (P = 0.009) independently differentiated those patients with and without coronary artery disease. A secondary analysis was conducted to relate the chest pain score to the Framingham and Duke scores. The chest pain score was found to have a sensitivity of 91.4% and a specificity of 28%, compared to the Duke score’s sensitivity of 82.4% and specificity of 31%. The study found that the combination of the chest pain score with Framingham and the Duke score had additive predictive value for risk of coronary artery disease
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Wu EB;Hodson F;Chambers JB;

A simple score for predicting coronary artery disease in patients with chest pain

Ref ID	394	QJM : monthly journal of the Association of Physicians	pgs:	803	to	811	2005

Study Type	Cohort	**Funding**	Grant from the special Trustee's of Guy's and St Thomas' NHS trust

Number of participant	404 patients recruited from 363 consecutive patients seen as out-patients, and 829 consecutive patients undergoing day-case coronary angiography. 155 of the 404 had an exercise test
Inclusion/Exclusion Criteria	Inclusion: chest pain for > 1 month without a previous history of MI, coronary angiography, angioplasty or coronary artery bypass grafting Exclusion: ECG showed pathological Q waves or regional wall motion abnormalities on echocardiogram
Patient Characteristics	The mean age was 60.6±9.5 years. 66% (268) were males, the mean age for males 60.5±9.1 years; 34% (137) were females, the mean ages for females was 60.8±10.2 years. Of all the patients 60% (244) had significant coronary artery disease; 40% (161) had normal coronary anatomy

Recruitment	Patients who met criteria recruited from out patients at Cardiothoracic Centre, Guy's and St Thomas' Hospital, London, UK
Setting	Guy's and St Thomas' Hospital, London, UK
Interventions/ Test/ Factor being investigated	Diagnosing chest pain
Comparisons	The chest pain score was based on: description of pain, clinical history, medication, clinical examination, stigmata of risk, resting ECG
Length of Study/ Follow-up	Not reported
Outcome measures studied	Diagnosis of coronary artery disease, or exclusion of diagnosis of coronary artery disease
Results	The chest pain score was based on the following: localisation of pain, radiation, quality of pain, duration, length of pain episode, frequency, associated features (breathlessness, digital paraesthesiae, palpation, light-headedness), precipitation (exercise, rest, any time, neck or back movement, carrying, swallowing, lying flat/stooping, emotional stress, particular situations), exacerbating / relieving factors (inspiration, GNT, genuine relief < 5 minutes) relief with (milk/antacids, belching, local massage rest). A medical history was also taken of: hypertension, hypercholesterolemia, diabetes, smoking and number of cigarettes per day, previous MI, alcohol intake per week, medication being used (aspirin, statins, beta blockers, calcium antagonists, nitrates, other), the patients weight, height, heart rhythm, systolic, diastolic, heart rate, apex position and character, intercostal space, heart murmur, heart sounds stigmata of risk (arcus, xanthelasmata, xanthomata, ear lobe crease) and a resting ECG. This chest pain score was based on a modification of the Master Questionnaire with 3 additional questions to define the exercise score, the rest and duration score. 1) if you go up a hill on 10 separate occasions how many do you experience chest pain; 2) if you have chest pain 10 times in a row how many happen when you are sitting or resting; 3) how long does the pain last for. For question 1 10/10 was described as “typical” and 1-9/10 was “atypical”; for question 2 a rest index or 0 or 1 was “typical and 2 or more was “atypical”; for question 3 pain lasting less than 5 minutes was “typical” and pain last more than 5 minutes was “atypical” Multivariant Poisson Regression Analysis, (see narrative for question 28; Table 6: Wu et al, 2005) showed that gender (P < 0.001), age (P < 001), relief with rest (P=0.046), dizziness (P=0.030), smoking (P=0.006), hypertension (P=0.016), hypercholesterolemia (P=0.214), diabetes (P=0.016) and chest pain score (P = 0.009) were independently differentiated those patients with and without CAD. A secondary analysis was conducted to relate the chest pain score to the Framingham and Duke Scores. The Duke Score is a weighted index based on ST-segment deviation, treadmill time and exercised-induced angina (Duke Treadmill Score = Exercise time – [5xSTdevistion] – [4xtreadmill angina]). The chest pain score was found to have a sensitivity of 91.4% and a specificity of 28%, compared to the Duke score’s sensitivity of 82.4% and specificity of 31%. The study found that the combination of the chest pain score with Framingham and the Duke score had additive predictive value for risk of coronary artery disease.
Safety and adverse effects	None reported
Does the study answer the question?	Multivariant Poisson regression analysis showed that gender (P < 0.001), age (P < 001), relief with rest (P=0.046), dizziness (P=0.030), smoking (P=0.006), hypertension (P=0.016), hypercholesterolemia (P=0.214), diabetes (P=0.016) and chest pain score were (P = 0.009) independently differentiated those patients with and without coronary artery disease. A secondary analysis was conducted to relate the chest pain score to the Framingham and Duke scores. The chest pain score was found to have a sensitivity of 91.4% and a specificity of 28%, compared to the Duke score’s sensitivity of 82.4% and specificity of 31%. The study found that the combination of the chest pain score with Framingham and the Duke score had additive predictive value for risk of coronary artery disease
Effect due to factor in study?	Yes

Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Grading: 2-	Case–control or cohort studies with a high risk of confounding bias, or chance and a significant risk that the relationship is not causal*

Cook DG;Shaper AG;

Breathlessness, angina pectoris and coronary artery disease

Ref ID 10282 The American journal of cardiology pgs: 921 to 924 1989

Study Type Cohort

Funding Royal Free Hospital, London; British Heart Foundation Research Group; Medical Research Council and Department of Health, London; The Chest Heart and Stroke Association; Scottish Home and Health Department; Greater Glasgow Health Board

Number of participant	7735 men
Inclusion/Exclusion Criteria	Random selection of men from different GP practices, patients were excluded if they had sever mental or physical disability
Patient Characteristics	Not reported
Recruitment	Random selection of men from different GP practices, patients were excluded if they had sever mental or physical disability
Setting	Primary care, UK
Interventions/ Test/ Factor being investigated	Breathlessness affecting Angina
Comparisons	Breathlessness and other risk factors
Length of Study/ Follow-up	5 years
Outcome measures studied	prevalence of Angina after 5 years
Results	See methodology at start of "results summary" below See narrative for question 26; Table 9: Cook and Shaper, 2004 Age-standardised prevalence rates of CAD by breathlessness grade: None: 6394 men, 3.5% recall, 6.5% ECG, 7% possible MI, 4.4% angina Mild: 697 men, 8.7% recall, 9.1% ECG, 12.6% possible MI, 15.5% angina Moderate: 358 men, 17.7% recall, 14.6% ECG, 21.6% possible MI, 28.8% angina Severe: 273 men, 27.6% recall, 18.5% ECG, 33.3% possible MI, 40.9% angina All: 7722 men, 5.5% recall, 7.6% ECG, 9.1% possible MI, 7.9% angina See narrative for question 26; Table 10: Cook and Shaper, 2004 Prevalence of angina by breathlessness grade: None: 89% none, 7% mild, 3% moderate, 1% severe Nonexertional pain: 79% none, 11% mild, 5% moderate, 4% severe Possible angina Grade 1: 51% none, 18% mild, 16% moderate, 15% severe Grade 2: 31% none, 9% mild, 17% moderate, 43% severe Definite angina Grade 1: 45% none, 22% mild, 19% moderate, 14% severe

Grade 2: 30% none, 2% mild, 20% moderate, 48% severe

See narrative for question 26; Table 11: Cook and Shaper, 2004
Mean levels of risk factors for CAD by breathlessness grade:
None: 49.9 years old, 39% smokers, 25.4 kg/m2 BMI, 144.9 mmHg systolic blood pressure, 6.30 mmol/l serum total cholesterol
Mild: 51.1 years old, 53% smokers, 26.1 kg/m2 BMI, 146.4 mmHg systolic blood pressure, 6.27 mmol/l serum total cholesterol
Moderate: 52.6 years old, 53% smokers, 26.2 kg/m2 BMI, 145.4 mmHg systolic blood pressure, 6.31 mmol/l serum total cholesterol
Severe: 53.5 years old, 52% smokers, 25.7 kg/m2 BMI, 143.4 mmHg systolic blood pressure, 6.24 mmol/l serum total cholesterol

See narrative for question 26; Table 12: Cook and Shaper, 2004
Age-standardised prevalence rate of angina in % by breathlessness grade and smoking:
None: 4.5% never smoked, 4.5% ex-smoker, 4.3% current smoker
Mild: 18.5% never smoked, 18.2% ex-smoker, 12.6% current smoker
Moderate: 25.7% never smoked, 26.7% ex-smoker, 30% current smoker
Severe: 25.5% never smoked, 36.5% ex-smoker, 45.9% current smoker
All: 6.2% never smoked, 7.9% ex-smoker, 8.6% current smoker

See narrative for question 26; Table 13: Cook and Shaper, 2004
Age-standardised prevalence rate of angina in % 5 years after initial screening:
None: 5.8% no angina, 47.1% angina
Mild: 13% no angina, 44.9% angina
Moderate: 24.6% no angina, 58.6% angina
Severe: 28.2% no angina, 74.4% angina

See narrative for question 26; Table 14: Cook and Shaper, 2004
Relation of breathlessness grade at screening to outcome at 5 years in men with no evidence of CAD:
None: 5228 men, 91.9% alive with no CAD, 4% alive with angina, 1.6% nonfatal MI, 0.9% dead from MI, 1.6% dead from non CAD cause
Mild: 471 men, 82.6% alive with no CAD, 10% alive with angina, 2.3% nonfatal MI, 0.8% dead from MI, 4.3% dead from non CAD cause
Moderate: 177 men, 72.7% alive with no CAD, 20.9% alive with angina, 2.1% nonfatal MI, 0.9% dead from MI, 3.4% dead from non CAD cause
Severe: 100 men, 62.8% alive with no CAD, 25.4% alive with angina, 2.7% nonfatal MI, 2.4% dead from MI, 6.7% dead from non CAD cause

Safety and adverse effects

None

Does the study answer the question?

This study is a publication from the British Regional Heart Study.
The men in the study were classified into 3 groups based on the smoking status (never smoked, ex-smoker, current smoker), their BMI was also recorded. A modified version of the Medical Research Council Questionnaire on Respiratory Symptoms (1966 version) was also carried out. The patient's lung function was also recorded based on the forced expiratory volume in 1 second measured using a Vitalograph J49-B2 spirometer, based on 2 consecutive readings 15 seconds apart (after an initial "practice"). The men were also split into two groups based on the presence or absence of CAD was also evaluated based on the World Health Organisation questionnaire on chest pain (which cover both CAD and MI), a 3-lead ECG recording and the patient reporting being given a diagnosis of angina or MI by a doctor. The patients were followed up for 5 years with 99% of the population being followed up. At the follow up there had been 166 nonfatal heart attacks, 119 fatal heart attacks or sudden cardiac deaths and 155 deaths from non-ischemic causes.

The study applied logistic models to find the age standardised prevalence and incidence rates of angina with age being the continuous variable. The study considered the relationship between breathlessness and chest pain, with the result of men with breathlessness being more likely to have angina than those with chest pain or with non-exertional chest pain. Breathlessness was also more common in those with grade 2 angina than those with grade 1 angina (however the study states that grade1 angina only had 95 men and was too small to be used in evaluation).
The study also considered the effect of smoking, which showed that smoking was not strongly related to breathlessness in men, with the rate of angina increasing dependant upon the breathlessness grade but not with smokers. This can be seen as men who had smoked had only a 39% higher rate of angina compared to those who

	had never smoked. The authors concluded that smoking was not an important risk factor for angina. However breathlessness was strongly related to angina (men with grade 2 or 3 breathlessness were 5 times as likely to develop angina after 5 years as those with graded 0 or 1). There was also a strong relationship between breathlessness and the presence of signs and symptoms of CAD.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Yes
Directly applicable to guideline population?	Mixed population, selected from GP practices
Internal Validity	Well covered

Question: 14 Are the symptoms and description of the symptoms different in women presenting with stable chest pain of suspected cardiac origin compared with men

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Diamond GA;Forrester JS;

Analysis of probability as an aid in the clinical diagnosis of coronary-artery disease

Ref ID 2196 The New England journal of medicine pgs: 1350 to 1358 1979

Study Type Cohort **Funding** Not reported.

Number of participant	Two separate cohorts assessed: 4952 patients referred for coronary angiography, 23 996 autopsies
Inclusion/Exclusion Criteria	Not applicable
Patient Characteristics	Suspected stable angina in 1 cohort (patients referred for angiogram) Patients were considered to have typical angina if they had substernal discomfort brought on by physical exertion and was relieved within 10 minutes through rest or nitroglycerin. Patients were considered to have atypical angina if they had discomfort which was either not substernal or was not bought on by exertion or not relieved after 10 minutes by rest or nitroglycerin. Patients were considered to have non-anginal discomfort if they did not have 1 or more of the above characteristics. Autopsy: general population
Recruitment	Patients referred for angiography
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Prevalence of coronary artery disease based on age, sex and symptoms.
Comparisons	Coronary angiography in 1 cohort, evidence of stenosis in 2 cohort at autopsy.
Length of Study/ Follow-up	Not applicable
Outcome measures studied	Prevalence of coronary artery disease based on age, sex and symptoms.
Results	In 4953 patients with stable chest pain referred for angiogram; the prevalence of disease in patients with typical angina symptoms was about 90%, whereas for atypical angina patients was a 50% prevalence ($P < 0.001$) and non-cardiac chest pain patients was 16% ($P < 0.001$). The prevalence of CAD observed at autopsy is similar to that in asymptomatic patients confirmed by coronary angiography. Significant differences in disease prevalence occurred when patients were classified according to age and sex. For women the differences range from 0.3% for women aged 30 years to 39 years of age, to 7% for women aged 60 years to 69 years. Women in all age ranges had a lower prevalence compared with the respective age ranges in men The pre-test likelihood of disease for any patients (according to any combination of age, sex and symptoms) was determined by conditional-probability analysis. There are a wide range of pre-test likelihoods according to sex, gender and symptoms. For example a women with atypical symptoms and aged 35% has a pre-test likelihoods of 4% compared with 92% for a man aged 55 years with typical symptoms. The authors noted that the approach used in the study was a mathematical formalisation of the intuition of the physicians reviewing the literature, or the use of

past experience to assess a patients' pre-test likelihoods. Both of these approaches relied upon the use of data from specific populations, but that they do provide reliable estimates of the probability of coronary artery disease based on the patients age, symptoms and gender.

Safety and adverse effects Not reported

Does the study answer the question? Yes. The study reviewed the literature to estimate the pre-test likelihood of disease (defined by age, sex and symptoms), and the results were analysed through Bayes' theorem of conditional probability. The studied described how the probability of CAD can be determined in a patient before testing from information readily obtained from clinical evaluation.
The study showed that combining data of the estimate of disease likelihood when the patient's age and sex are known and a second estimate when the presence or absence of symptoms are known provides an estimate of the pre-test likelihood of disease for any patients based on any combination of age, sex and symptoms can be determined by conditional-probability analysis. For example, the likelihood of a woman having CAD at age ranges less than 59 years and with typical angina symptoms will be lower than a man with in the comparable age ranges.

Effect due to factor in study? Yes

Consistency of results with other studies? Consistent

Directly applicable to guideline population? Patients in cohort used to develop theoretical pre-test likelihoods had stable chest pain, directly applicable to the guideline.

Internal Validity Well covered

Zaman MJ;Junghans C;Sekhri N;Chen R;Feder GS;Timmis AD;Hemingway H;

Presentation of stable angina pectoris among women and South Asian people.[see comment]

Ref ID 25388 CMAJ Canadian Medical Association Journal 179(7):659-67, pgs: 659 to 667 2008

Study Type Cohort

Funding In part, British Heart Foundation for primary author

Number of participant Of 11 082 patients seen at the rapid chest pain access clinic the following patients where excluded; 579 previous CAD, 246 patients diagnosed with ACS on day of visit, 448 prior visit to the unit during study period, 291 no chest pain, 501 due to missing data, 83 pain not diagnosed with angina, 40 not tracked by the Office for National Statistics, 968 excluded as other ethnic background (not Caucasian or Asian). Thus of the final number of people identified (7794), 2676 were Caucasian women, 2929 were Caucasian men, 980 were South Asian women, and 1209 were South Asian men

Inclusion/Exclusion Criteria Inclusion: suspected angina, recent onset chest pain

Patient Characteristics Women South Asian median age 57.6 years (49 to 67 years), Women Caucasian median age 50.6 years (42 to 58 years) ($P < 0.001$), Men South Asian median age 49.8 years (41 to 69 years), Men Caucasian median age 54.7 years (45 to 65 years) ($P < 0.001$). South Asian versus Caucasian women more likely to have diabetes and hypertension, less likely to smoke. South Asian versus Caucasian men more likely to have hypertension, less likely to smoke.

Recruitment Consecutive recent onset chest pain from 6 rapid access chest pain clinics

Setting UK rapid access chest pain clinics

Interventions/ Test/ Factor being investigated	Gender and race presentation atypical versus typical pain
Comparisons	Gender and race presentation atypical versus typical pain, outcomes of death from ACS and hospital admission due to ACS (coded according to ICD-10 classification) determined up to 3 years of clinic visit.
Length of Study/ Follow-up	3 years from clinic visit
Outcome measures studied	Outcomes of death from ACS and hospital admission due to ACS (coded according to ICD-10 classification)
Results	More women than men reported atypical chest pain symptoms (56.5% versus 54.5%, respectively P = 0.054). Cardiologists were more likely to describe the symptoms of women as atypical compared with men (73.3% agreement between cardiologist summary and the symptom score, kappa statistic 0.43). With respect to symptoms and diagnosis, sex did not modify the association between exercise echocardiology results and receiving a diagnosis of angina, and after excluding patients with a positive exercise test result, cardiologist and typical symptom scores both remained predictive of a diagnosis of angina. With respect to symptoms and prognosis, using cardiologist summaries typical symptoms in women were more strongly associated with coronary death or ACS (hazard ratio 3.74, 95% CI 2.80 to 5.01) than among men (hazard ratio 1.51, 95% CI 1.16 to 1.97, P < 0.001). This finding was also true for symptom scores (women; hazard ratio 2.30, 95% CI 1.70 to 3.11, men; hazard ratio 1.23, 95% CI 0.96 to 1.57, P < 0.002). According to cardiologist summaries and symptom scores, women with typical symptoms were more likely than men to have coronary outcomes (cardiologist summaries for women hazard ratio 1.49, 95% CI 1.09 to 2.04, and symptom score for women hazard ratio 1.39, 95% CI 1.06 to 1.84). Women with atypical symptoms were less likely than men with atypical symptoms to experience a coronary outcome (unadjusted log rank test P = 0.001), although adjusted Cox regression ratios showed that atypical pain had similar prognostic value for coronary outcomes for women and men. The authors stated that compared to those with atypical chest pain, women with typical symptoms had worse clinical outcomes More South Asians compared with Caucasians reported atypical chest pain symptoms (59.9% versus 52.5%, respectively P < 0.001), and the cardiologist described more South Asians as having atypical presentation compared with Caucasians. South Asians were also more likely to report pain that was not associated with exercise. With respect to symptoms and diagnosis, ethnicity did not modify the association between exercise echocardiology results and receiving a diagnosis of angina, and after excluding patients with a positive exercise test result, cardiologist and typical symptom scores both remained predictive of a diagnosis of angina. According to cardiologist summaries and symptom scores, South Asians with typical symptoms were as likely as Caucasians with typical symptoms to have a coronary outcome for cardiologist summaries (hazard ratio 1.27, 95% CI 0.89 to 1.81), and more likely with symptom scores (hazard ratio 1.41, 95% CI 1.04 to 1.91). Among South Asians with atypical symptoms, the symptom score was associated with coronary outcomes (unadjusted log rank test P = 0.30), although adjusted Cox regression ratios showed that atypical pain had similar prognostic value for coronary outcomes across ethnic background.
Safety and adverse effects	Not applicable
Does the study answer the question?	The authors stated that compared to those with atypical chest pain, women with typical symptoms had worse clinical outcomes, with atypical chest pain, South Asians with typical symptoms had worse clinical outcomes.
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Chest pain patients with suspected angina, directly relevant to guideline

Internal Validity	Well covered

Question 16: What is the utility (incremental value) and cost effectiveness of the resting ECG in evaluation of individuals with stable chest pain of suspected cardiac origin?

Grading: 1++	High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias

Chun AA;McGee SR;

Bedside diagnosis of coronary artery disease: a systematic review

Ref ID 10275 The American journal of medicine pgs: 334 to 343 2004

Study Type Systematic Review

Funding Not reported

Number of participant 64 studies

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

The paper reviewed both studies of acute patients and stable patients.
Acute patients
The review considered patients with acute chest pain of suspected cardiac origin, ECG changes were found to the most discriminating criteria for the diagnosis of acute MI compared with signs and symptoms and risk factors. For a normal ECG the sensitivity was 1 to 13%, specificity was 48 to 77%, LR+ 0.20 (95%CI 0.1 to 0.3) and LR- 1.4 (95% CI 1.4 to 1.6). For ST-T wave abnormalities the sensitivity was 5 to 7%, specificity was 47 to 77%, LR+ 0.20 (95%CI 0.1 to 0.6) and LR- 1.5 (95% CI 0.9 to 2.6). For ST elevation the sensitivity was 31 to 49%, specificity was 97 to 100%, LR+ 22 (95%CI 16 to 30) and LR- 0.6 (95% CI 0.6 to 0.6). For ST depression the sensitivity was 20 to 62%, specificity was 88 to 96%, LR+ 4.5 (95%CI 3.6 to 5.6) and LR- 0.8 (95% CI 0.7 to 0.9). Q wave had a sensitivity of 10 to 34% and a specificity of 96 to 100%, LR+ 22 (95% CI 7.6 to 62) and LR- 0.8 (95% CI 0.8 to 0.9). T wave inversion had a sensitivity of 9 to 39%, and a specificity of 84 to 94%, LR+ 2.2 (95%CI 1.8 to 2.6) and LR- 0.9 (95% CI 0.8 to 1.0)

The review found that for diagnosing coronary artery disease in patients with stable chest pain the ECG gave little additional diagnostic information to the history and risk factor findings

Stable patients:
Most studies, in patients presenting with stable intermittent chest pain were then referred for coronary angiography. The majority of these studies excluded patients

	with valvular heart disease or non-ischaemic cardiomyopathy. The studies used either > 50% stenosis or 70-75% stenosis off any epicardial vessel as the diagnostic standard (see narrative for question 3; Table 1: Chun and McGee, 2004 and Table 2: Chun and McGee, 2004). Patients presenting with acute MI were hospitalised for further monitoring and testing. The review found that for diagnosing coronary artery disease the ECG gave little additional diagnostic information. A normal ECG gave a sensitivity of 23 to 33%, a specificity of 50-69%, LR+ 0.7 (95%CI 0.3 to 1.6) and a LR- 1.2 (95%CI 0.8 to 1.9). For ST-T wave abnormalities the sensitivity was 14 to 44%, specificity was 73 to 93%, LR+ 1.4 (95%CI 1.0 to 1.9) and LR- 0.9 (95% CI 0.9 to 1.0) (see narrative for question 3; Table 3: Chun and McGee, 2004).
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Pryor DB;Harrell FE;Lee KL;Califf RM;Rosati RA;

Estimating the likelihood of significant coronary artery disease

Ref ID	10283	The American journal of medicine	pgs:	771	to	780	1983

Study Type	Cohort	**Funding**	Not reported

Number of participant	3627 in training population, 1811 in test population
Inclusion/Exclusion Criteria	Patients with chest pain who were referred for cardiac catheterization at the Duke University Medical Center between November 1969 and January 1982
Patient Characteristics	Patient characteristics which were collected were: History: age, sex, chest pain history (pain type, severity, frequency, nocturnal, progressive, preinfarctional), duration of CAD, previous history of MI, congestive heart failure, history of vascular disease (Progressive chest pain - the frequency, severity or duration had increased in the 6 weeks prior to catherisation; Preinfarctional chest pain - a very unstable pain pattern that resulted in admission to the coronary care unit for evaluation of the possible MI) Risk factors: smoking, hyperlipidaemia, hypertension, diabetes, family history Physical examination: ventricular gallop, systolic blood pressure ECG: ST-T wave changes, electrocardiographic premature ventricular contractions, Electrocardiographic Q waves Chest X-Ray: cardiomegaly
Recruitment	Patients admitted for cardiac catheterisation between November 1969 and January 1982
Setting	Secondary care, USA
Interventions/ Test/ Factor being investigated	Chest pain diagnosis
Comparisons	Patient characteristics which give a probability of disease
Length of Study/ Follow-up	
Outcome measures studied	Probability of disease
Results	The study had a training population of 3627 patients who were seen between 1969 and January 1979, from these patients a stepwise logistic regression analysis was used to develop a model for predicting the probability of significant CAD. A test population of 1811 patients seen between January 1969 and January 1982, in this population the model developed in the test population was used to predict the probability of CAD for each patient. The authors then tested the model in other populations (from CASS study) to estimate the prevalence of disease in subgroups of the patients in the literature (external validation) Results from training population: See narrative for question 3; Table 14:Pryor et al, 1983 Clinically Important Characteristics and the Chi-squared: Pain type (typical, atypical or nonanginal): 1091 Previous MI: 511

Sex: 187
Age: 119
Smoking: 79
Hyperlipidaemia: 26
ST-T wave changes: 28
Diabetes: 12

Poor Clinical Predictors of Significant CAD and the Chi-squared: See narrative for question 3; Table 15:Pryor et al, 1983
Chest pain severity: 0.96
Chest pain frequency: 8.57
Nocturnal chest pain: 2.22
Progressive chest pain: 2.54
Preinfarction angina: 9.70
Vascular disease: 0.40
Duration of CAD: 9.16
Congestive heart failure: 0.59
Hypertension: 5.19
Family history: 6.39
Ventricular gallop: 1.06
Cardiomegaly: 1.41
Electrocardiographic premature ventricular contractions: 0.46

The results from the training group are shown under “Clinically Important Characteristics and the Chi-squared” in the order of their importance (chi-squared added to the model by the parameter, adjusting for the characteristics that precede it). ST-T wave changes was shown to be a clinically important characteristics in predicting significant CAD, as were the type of chest pain (typical, atypical or nonanginal) was the most important characteristic followed by previous MI, sex, age, smoking, hyperlipidaemia and diabetes. Electrocardiographic premature ventricular contractions were shown to be poor predictors of significant CAD.

The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence. The authors then externally validated using the population from the CASS study. There was disagreement on patients classified as having nonanginal chest pain (where the greatest difference in predicted disease compared to observed disease was seen), but the predicted estimates from the model were nearly equal to the observed prevalence of disease.

Safety and adverse effects

None

Does the study answer the question?

Progressive chest pain was described as being chest pain when the frequency, severity or duration had increased in the 6 weeks prior to catherisation. Preinfarctional chest pain was described as chest pain with a very unstable pain pattern that resulted in admission to the coronary care unit for evaluation of the possible MI

The results from the training population showed the ST-T wave changes was an most important characteristic for predicting significant CAD, but electrocardiographic premature ventricular contractions were shown to be a poor predictor of significant CAD.

The authors then validated the model in the test population which showed that the predicted probability of disease is nearly identical to the observed prevalence. When comparing the model to an external population the study showed that the predicted estimates from the model were nearly equal to the observed prevalence of disease.

Effect due to factor in study?

Yes

Consistency of results with other studies?

Consistent

Directly applicable to guideline population?

Patients had chest pain

Internal Validity

Well covered

Pryor DB;Shaw L;McCants CB;Lee KL;Mark DB;Harrell FE;Muhlbaier LH;Califf RM;

Value of the history and physical in identifying patients at increased risk for coronary artery disease

Ref ID 1751 Annals of internal medicine pgs: 81 to 90 1993

Study Type	Cohort	**Funding**	Agency for Health Care Policy and Research, National Heart, Lung and Blood institute, National Library of Medicine

Number of participant	1030 patients, 168 had cardiac catheterization
Inclusion/Exclusion Criteria	Inclusion: Symptomatic patients, referred for non-invasive testing for suspected coronary artery disease Exclusion: previous cardiac catheterization
Patient Characteristics	The mean age was 55, 37% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 12 months, 28% had typical angina symptoms, 52% atypical angina symptoms, 20% nonanginal pain, 18% progressive angina, 22% nocturnal angina, 44% smoked, 41% had a history of hypertension, 10% had diabetes, 11% had hyperlipidemia, 35% had ST-T wave changes on ECG, 18% had a history of MI, 8% had Q waves on ECG, 14% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 3% had peripheral vascular disease, 3% had cerebral vascular disease Of the patients who went on to have a cardiac catheterization the mean age was 56, 31% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 7 months, 49% had typical angina symptoms, 47% atypical angina symptoms, 4% nonanginal pain, 24% progressive angina, 24% nocturnal angina, 53% smoked, 42% had a history of hypertension, 10% had diabetes, 13% had hyperlipidemia, 42% had ST-T wave changes on ECG, 33% had a history of MI, 11% had Q waves on ECG, 11% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 4% had peripheral vascular disease, 2% had cerebral vascular disease. It can therefore be seen that those having a cardiac catheterization were more likely to be male, smoke, have a history of MI, have ST-T wave changes on ECG and to be suffering typical or progressive angina
Recruitment	Patients were referred for non-invasive testing for suspected coronary artery disease
Setting	Duke University Medical Centre USA
Interventions/ Test/ Factor being investigated	Physicians initial evaluation of patients with suspected CAD predicts coronary anatomy
Comparisons	The presence of significant coronary disease defined as any disease, severe disease, left main disease
Length of Study/ Follow-up	90 days
Outcome measures studied	Effectiveness of chest pain score to predict coronary artery disease
Results	The three diagnostic outcomes were; the presence of significant coronary artery disease defined as ‘any disease’ (≥ 75% luminal diameter narrowing of at least one major coronary artery), presence of severe coronary artery disease defined as ‘severe disease’ (significant obstruction of all 3 main coronary arteries or the left main coronary artery) and the presence of significant left main artery obstruction defined as ‘left main disease’ (168 patients referred for cardiac catheterization). The prognostic outcome was survival at 3 years. In the multivariable regression model used, the following variables were significant predictors for any disease; significant Q waves and ST-T wave changes (as well as age, gender, chest pain (type), diabetes, smoking, hyperlipidaemia and previous history of myocardial infarction). For severe disease, the following variables were

	significant predictors; significant Q waves and ST-T wave changes (as well as age, gender, chest pain (type, frequency, course, nocturnal, length of time present), diabetes, smoking, hyperlipidaemia, hypertension, peripheral or cerebral artery disease, carotid bruit and previous history of myocardial infarction). For left main disease ECG changes were not significant predictors. For survival at 3 years the following variables were significant predictors; significant Q waves and ST-T wave changes, conduction abnormalities, (as well as age, gender, chest pain (frequency, course, nocturnal), peripheral or cerebral artery disease, carotid bruit, ventricular gallop, previous history of myocardial infarction, premature ventricular contractions and cardiomegaly). The likelihood of any disease, severe coronary disease, left main disease and survival was predicted from the initial history, physical examination, electrocardiogram and chest X ray (these tests were defined as the 'initial evaluation'). The models which were used were based on mathematical models in a previous study (Pryor, 1983 – see extraction). Predicted coronary artery endpoints and survival based on the initial evaluation closely corresponded to actual findings. Predictions using the initial evaluation were then compared with predictions based on the treadmill exercise test. The initial evaluation was slightly better at distinguishing patients with and without coronary artery disease compared with the treadmill exercise test. The initial evaluation and the treadmill exercise test had similar discriminatory performances for patients with and without severe disease and risk of death at 3 years, while for left main disease, the treadmill exercise test was slightly better for identify patients with left main disease.
Safety and adverse effects	None reported
Does the study answer the question?	In the multivariable regression model used, the following variables were significant predictors for any disease; significant Q waves and ST-T wave changes. For severe disease, the following variables were significant predictors; significant Q waves and ST-T wave changes. For left main disease ECG results were not significant predictors. For survival at 3 years the following variables were significant predictors; significant Q waves and ST-T wave changes. The likelihood of any disease, severe coronary disease, left main disease and survival was predicted from the initial history, physical examination, electrocardiogram and chest X ray (these tests were defined as the 'initial evaluation'). Predicted coronary artery endpoints and survival based on the initial evaluation closely corresponded to actual findings. Predictions using the initial evaluation were then compared with predictions based on the treadmill exercise test. The initial evaluation was slightly better at distinguishing patients with and without coronary artery disease compared with the treadmill exercise test. The initial evaluation and the treadmill exercise test had similar discriminatory performances for patients with and without severe disease and risk of death at 3 years, while for left main disease, while the treadmill exercise test was slightly better for identify patients with left main disease. The models which were used were based on mathematical models in a previous study (Pryor, 1983 – see extraction).
Effect due to factor in study?	Yes
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Pryor DB;Shaw L;McCants CB;Lee KL;Mark DB;Harrell FE;Muhlbaier LH;Califf RM;

Value of the history and physical in identifying patients at increased risk for coronary artery disease

Ref ID 1751 Annals of internal medicine pgs: 81 to 90 1993

Study Type Cohort

Funding Agency for Health Care Policy and Research, National Heart, Lung and Blood institute, National Library of Medicine

Number of participant	1030 patients, 168 had cardiac catheterization
Inclusion/Exclusion Criteria	Inclusion: Symptomatic patients, referred for non-invasive testing for suspected coronary artery disease Exclusion: previous cardiac catheterization
Patient Characteristics	The mean age was 55, 37% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 12 months, 28% had typical angina symptoms, 52% atypical angina symptoms, 20% nonanginal pain, 18% progressive angina, 22% nocturnal angina, 44% smoked, 41% had a history of hypertension, 10% had diabetes, 11% had hyperlipidemia, 35% had ST-T wave changes on ECG, 18% had a history of MI, 8% had Q waves on ECG, 14% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 3% had peripheral vascular disease, 3% had cerebral vascular disease Of the patients who went on to have a cardiac catheterization the mean age was 56, 31% were female, the mean pain frequency was 2 episodes a week, the mean durations of CAD symptoms was 7 months, 49% had typical angina symptoms, 47% atypical angina symptoms, 4% nonanginal pain, 24% progressive angina, 24% nocturnal angina, 53% smoked, 42% had a history of hypertension, 10% had diabetes, 13% had hyperlipidemia, 42% had ST-T wave changes on ECG, 33% had a history of MI, 11% had Q waves on ECG, 11% had a history of congestive heart failure, 0% had class IV congestive heart failure, 1% had ventricular gallop, 4% had peripheral vascular disease, 2% had cerebral vascular disease. It can therefore be seen that those having a cardiac catheterization were more likely to be male, smoke, have a history of MI, have ST-T wave changes on ECG and to be suffering typical or progressive angina
Recruitment	Patients were referred for non-invasive testing for suspected coronary artery disease
Setting	Duke University Medical Centre USA
Interventions/ Test/ Factor being investigated	Physicians initial evaluation of patients with suspected CAD predicts coronary anatomy
Comparisons	The presence of significant coronary disease defined as any disease, severe disease, left main disease
Length of Study/ Follow-up	90 days
Outcome measures studied	Effectiveness of chest pain score to predict coronary artery disease
Results	The three diagnostic outcomes were; the presence of significant coronary artery disease defined as ‘any disease’ (≥ 75% luminal diameter narrowing of at least one major coronary artery), presence of severe coronary artery disease defined as ‘severe disease’ (significant obstruction of all 3 main coronary arteries or the left main coronary artery) and the presence of significant left main artery obstruction defined as ‘left main disease’ (168 patients referred for cardiac catheterization). The

prognostic outcome was survival at 3 years.
In the multivariable regression model used, the following variables were significant predictors for any disease; age, gender, chest pain (type), diabetes, smoking, hyperlipidaemia, previous history of myocardial infarction, and significant Q waves and ST-T wave changes. For severe disease, the following variables were significant predictors; age, gender, chest pain (type, frequency, course, nocturnal, length of time present), diabetes, smoking, hyperlipidaemia, hypertension, peripheral or cerebral artery disease, carotid bruit, previous history of myocardial infarction, and significant Q waves and ST-T wave changes. For left main disease, the following variables were significant predictors; age, gender, chest pain (type), diabetes, peripheral or cerebral artery disease and carotid bruit. For survival at 3 years the following variables were significant predictors; age, gender, chest pain (frequency, course, nocturnal), peripheral or cerebral artery disease, carotid bruit, ventricular gallop, previous history of myocardial infarction, significant Q waves and ST-T wave changes, conduction abnormalities, premature ventricular contractions and cardiomegaly. The likelihood of any disease, severe coronary disease, left main disease and survival was predicted from the initial history, physical examination, electrocardiogram and chest X ray (these tests were defined as the 'initial evaluation'). The models which were used were based on mathematical models in a previous study (Pryor, 1983 – see extraction).
Predicted coronary artery endpoints and survival based on the initial evaluation closely corresponded to actual findings. Predictions using the initial evaluation were then compared with predictions based on the treadmill exercise test. The initial evaluation was slightly better at distinguishing patients with and without coronary artery disease compared with the treadmill exercise test. The initial evaluation and the treadmill exercise test had similar discriminatory performances for patients with and without severe disease and risk of death at 3 years, while for left main disease, the treadmill exercise test was slightly better for identify patients with left main disease.

Safety and adverse effects

None reported

Does the study answer the question?

In the multivariable regression model used, the following variables were significant predictors for any disease; age, gender, chest pain (type), diabetes, smoking, hyperlipidaemia, previous history of MI, and significant Q waves and ST-T wave changes. For severe disease, the following variables were significant predictors; age, gender, chest pain (type, frequency, course, nocturnal, length of time present), diabetes, smoking, hyperlipidaemia, hypertension, peripheral or cerebral artery disease, carotid bruit, previous history of MI, and significant Q waves and ST-T wave changes. For left main disease, the following variables were significant predictors; age, gender, chest pain (type), diabetes, peripheral or cerebral artery disease and carotid bruit. For survival at 3 years the following variables were significant predictors; age, gender, chest pain (frequency, course, nocturnal, peripheral or cerebral artery disease, carotid bruit, ventricular gallop, previous history of MI, significant Q waves and ST-T wave changes, conduction abnormalities, premature ventricular contractions and cardiomegaly. The likelihood of any disease, severe coronary disease, left main disease and survival was predicted from the initial history, physical examination, electrocardiogram and chest X ray (these tests were defined as the 'initial evaluation').

Predicted coronary artery endpoints and survival based on the initial evaluation closely corresponded to actual findings. Predictions using the initial evaluation were then compared with predictions based on the treadmill exercise test. The initial evaluation was slightly better at distinguishing patients with and without coronary artery disease compared with the treadmill exercise test. The initial evaluation and the treadmill exercise test had similar discriminatory performances for patients with and without severe disease and risk of death at 3 years, while for left main disease, while the treadmill exercise test was slightly better for identify patients with left main disease. The models which were used were based on mathematical models in a previous study (Pryor, 1983 – see extraction).

During the study a chest X-ray was also performed, the results did not help in predicting coronary disease, however they could be used to predict survival.

Effect due to factor in study?

Yes

Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Correct population
Internal Validity	Well covered

Question: 17 What is the diagnostic utility of calcium scoring for the evaulation of patients with stable chest pain of cardiac origin.

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Becker CR;Knez A;Jakobs TF;Aydemir S;Becker A;Schoepf UJ;Bruening R;Haberl R;Reiser MF;

Detection and quantification of coronary artery calcification with electron-beam and conventional CT

Ref ID 11854 Eur Radiol pgs: 620 to 624 1999

Study Type Diagnostic **Funding** Not reported.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? 106 consecutive patients, 81% had positive calcium score. Mean Agatston score and Volume score were 401±382 (range 0 to 6941) and 348±299 (range 0 to 5827). Total calcium scores were higher for men compared with women regardless of angiographic status (P = 0.001). Overall sensitivity and specificity for both scores to predict stenosis was 99% and 37%, respectively, when calcification of > 1 was used as a cut-off. Sensitivity and specificity dependant upon calcium scores threshold. There was a close correlation in diagnostic accuracy of the Agatston score compared with the Volume score (r = 0.99).

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results are directly applicable.

Internal Validity

Budoff MJ;Diamond GA;Raggi P;Arad Y;Guerci AD;Callister TQ;Berman D;

Continuous probabilistic prediction of angiographically significant coronary artery disease using electron beam tomography

Ref ID 9143 Circulation pgs: 1791 to 1796 2002

Study Type Diagnostic **Funding** Not reported.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? Of the 1851 patients, 1466 (79%) had a total calcium score of > 0 (range from 1 to 6649). Overall sensitivity prediction of obstructive CAD was 96% and specificity was 40% for calcium scoring. For calcium scores >20, >80 and >100, sensitivity decreased from 90% to 79% to 76%, specificity increased from 58% to 72% to 75%. Of 1851 patients, 938 (53%) had luminal stenosis greater 50% in 1 or more vessels, and their mean total calcium score was 608 (range 0 to 6646). Calcium scores were lower for patients without obstructive disease (838 patients, mean calcium score 123 with range 0 to 3761, P > 0.001) compared with patients with obstructive disease. Calcium scoring considerably alters the post test probability across a wide range of patients. Patients that exhibited the greatest change from pre- to post-test probability were those patients with pre-test probabilities ranging from 20% to 70%.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results are directly applicable.

Internal Validity

Haberl,R.; Becker,A.; Leber,A.; Knez,A.; Becker,C.; Lang,C.; Bruning,R.; Reiser,M.; Steinbeck,G.

Correlation of coronary calcification and angiographically documented stenoses in patients with suspected coronary artery disease: results of 1,764 patients

Ref ID 10437 Journal of the American College of Cardiology pgs: 451 to 457 2001

Study Type	Diagnostic	**Funding**	
Number of participant			
Inclusion/Exclusion Criteria			
Patient Characteristics			
Recruitment			
Setting			
Interventions/ Test/ Factor being investigated			
Comparisons			
Length of Study/ Follow-up			
Outcome measures studied			
Results			
Safety and adverse effects			
Does the study answer the question?	Men had higher calcium compared with women, increasing age was associated with higher scores, and calcium scores in patients with coronary artery disease were higher than those patients without coronary artery disease. No calcium was detected in 128 (23.7%) of 540 men and in 116 (40.8%) of 284 women without significant coronary artery disease, as compared with 5 (0.7%) of 685 men and 0 of 255 women with coronary stenoses greater than or equal to 50%. Thus, exclusion of coronary calcification was associated with an extremely low probability of stenoses greater than or equal to 50% in men and women. At various score ranges. The sensitivities for calcium scores were higher than their respective specificities and this was especially marked for a score > 0 (any calcium detected) (sensitivities; 99% in men and 100% in women, specificities; 23% in men and 40% in women).		
Effect due to factor in study?			
Consistency of results with other studies?			
Directly applicable to guideline population?	results are directly applicable.		
Internal Validity	Well covered		

Knez A;Becker A;Leber A;White C;Becker CR;Reiser MF;Steinbeck G;Boekstegers P;

Relation of coronary calcium scores by electron beam tomography to obstructive disease in 2,115 symptomatic patients

Ref ID 6184 Am J Cardiol pgs: 1150 to 1152 2004

Study Type	Diagnostic	**Funding**	Not reported
Number of participant			

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

2115 patients referred by primary care physicians with suspected myocardial ischaemia (with no prior CAD), 1789 patients (84%) had positive Ca score (> 0). Patients with CAD versus patients without CAD Agatston score 492±1124 versus 323±842 / Volumetric 486±842 versus 53± 175. No CAD found in 326 symptomatic patients without coronary calcium (7 men and 1 woman had no calcium but had significant luminal stenosis on coronary angiography). Sensitivity and specificity for presence of any coronary calcium being predicative of obstructive angiographic disease were 99% and 28% respectively. For prediction of coronary stenosis a Volume score in the 75th percentile best compromise of a sensitivity 85% and specificity 80%, an Agatston score sensitivity 86% and specificity 75%. ROC curve analysis showed best results for patients age < 40 years.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

The results are directly applicable.

Internal Validity

Konieczynska M;Tracz W;Pasowicz M;Przewlocki T;

Use of coronary calcium score in the assessment of atherosclerotic lesions in coronary arteries

Ref ID 2708 Kardiol Pol pgs: 1073 to 1079 2006

Study Type Diagnostic

Funding Not reported.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

340 patients had mean calcium score 271±606 (range 0 to 7002). 92 patients had score of 0 / 248 patients > 0. 162 patients (48%) no significant angiographic legions. Mean calcium scores increased with coronary artery disease severity, and the calcium score mean differences were significant comparing patients without coronary stenosis, and patients with vessel disease, respectively (P < 0.001). Patients with > 70% stenosis and three-vessel disease had median score of 3740 (range 2635 to 4716, 3 patients). For calcium score greater or equal to 56 sensitivity 86% and specificity 85%. PPV 86% and NPV 84%. 92 patients (27%) had calcium scores of 0: 44 women and 48 men. In 44 women coronary angiography no stenosis. In 6 men (6.5%) with calcium scores of 0, coronary angiography found stenoses; single vessel disease in 3 men, 2 vessel disease in 2 men, and 3 vessel disease in 1 man.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

The results are directly applicable.

Internal Validity

Pundziute G;Schuijf JD;Jukema JW;Lamb HJ;de RA;van der Wall EE;Bax JJ;

Impact of coronary calcium score on diagnostic accuracy of multislice computed tomography coronary angiography for detection of coronary artery disease

Ref ID 2334 J Nucl Cardiol pgs: 36 to 43 2007

Study Type Diagnostic

Funding European Society of Cardiology and Netherlands Heart Foundation.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting	
Interventions/ Test/ Factor being investigated	
Comparisons	
Length of Study/ Follow-up	
Outcome measures studied	
Results	
Safety and adverse effects	
Does the study answer the question?	41 patients 16 slice-CT and 60 patients 64-slcie CT. 16-slice MSCT: coronary angiography detected obstructive coronary lesions in 18 (44%) patients, and overall calcium score sensitivity and specificity values 89% and 87%. 64-slice MSCT: coronary angiography detected obstructive coronary lesions in 32 (53%) patients, and the overall sensitivity and specificity values 91% and 96%. There was little difference in the diagnostic accuracy of 16- and 64-slice MSCT between the four Agatston groups (0 to 100, 101 to 400, > 400 and > 100) Patients with > 70% stenosis and only single vessel involvement had a median score of 482 (range 23 to 2450, 12 patients).
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	The results are directly applicable.
Internal Validity	

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Herzog C;Britten M;Balzer JO;Mack MG;Zangos S;Ackermann H;Schaechinger V;Schaller S;Flohr T;Vogl TJ;

Multidetector-row cardiac CT: diagnostic value of calcium scoring and CT coronary angiography in patients with symptomatic, but atypical, chest pain

Ref ID 6464 Eur Radiol pgs: 169 to 177 2004

Study Type Diagnostic **Funding** Not reported.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? 38 consecutive patients. For calcium score > 0: sensitivity 94%, specificity 25%, PPV 52%, NPV 80%. For calcium score > 400, sensitivity 67%, specificity 25%, PPV 75%, NPV 72%. Highly significant correlation between calcium score and degree of CAD. Patients with no signs of atherosclerosis from coronary angiography (20 patients) mean total scores of 104 (range 0 to 1459). Patients with > 70% stenosis and only single vessel involvement had a median score of 482 (range 23 to 2450, 12 patients). Patients with > 70% stenosis and three-vessel disease had median score of 3740 (range 2635 to 4716, 3 patients).

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results are directly applicable.

Internal Validity

Kitamura A;Kobayashi T;Ueda K;Okada T;Awata N;Sato S;Shimamoto T;

Evaluation of coronary artery calcification by multi-detector row computed tomography for the detection of coronary artery stenosis in Japanese patients

Ref ID 4238 J Epidemiol pgs: 187 to 193 2005

Study Type Diagnostic **Funding** Not reported.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? 38 consecutive patients. For calcium score > 0: sensitivity 94%, specificity 25%, PPV 52%, NPV 80%. For calcium score > 400, sensitivity 67%, specificity 25%, PPV 75%, NPV 72%. Highly significant correlation between calcium score and degree of CAD. Patients with no signs of atherosclerosis from coronary angiography (20 patients) mean total scores of 104 (range 0 to 1459). Patients with > 70% stenosis and only single vessel involvement had a median score of 482 (range 23 to 2450, 12 patients). Patients with > 70% stenosis and three-vessel disease had median score of 3740 (range 2635 to 4716, 3 patients).

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results are directly applicable.

Internal Validity

Lau GT;Ridley LJ;Schieb MC;Brieger DB;Freedman SB;Wong LA;Lo SK;Kritharides L;

Coronary artery stenoses: detection with calcium scoring, CT angiography, and both methods combined

Ref ID 4898 Radiology pgs: 415 to 422 2005

Study Type Diagnostic **Funding** Departments of Cardiology and Radiology, Concord

Hospital, National Heart Foundation of Australia and Pfizer Cardiovascular Lipid Research Grant.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? 50 consecutive patients. Coronary stenosis greater 50% present in 30 (60%) of 50 patients. 14 patients had single vessel disease 16 sixteen patients had multivessel disease. Sensitivity and specificity varied according to calcium score thresholds. Mean calcium scores were higher in patients with stenosis compared with patients without stenosis: 700±541 versus 99±140 (P < 0.001). Calcium score to discriminate between the presence or absence of stenosis greater for patients than for individual vessels and segments as demonstrated by ROC curve analysis (area under ROC curve 0.88, 0.84 and 0.74, respectively).

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results are directly applicable.

Internal Validity

Raff GL;Gallagher MJ;O'Neill WW;Goldstein JA;

Diagnostic accuracy of noninvasive coronary angiography using 64-slice spiral computed tomography.

Ref ID 4496 J Am Coll Cardiol pgs: 552 to 557 2005

Study Type Diagnostic

Funding Ministrelli Cardiovascular Research Fund.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

70 consecutive patients. The mean calcium score in patients was 326±472. 35 patients: scores from 0 to 100 / 17 patients scores of 101 to 400, and 18 out of 70 had scores of 401 to 1804. When a calcium score was low (0 to 100), sensitivity, specificity, and positive and negative predictive values for the presence of significant stenosis (stenosis > 50%) were 94%, 95%, 94% and 95%. Diagnostic accuracy was also good for score 101 to 400, however, with extreme calcification the specificity and negative predictive values were reduced (both 67%).

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

The results are directly applicable.

Internal Validity

Rubinshtein R;Gaspar T;Halon DA;Goldstein J;Peled N;Lewis BS;

Prevalence and extent of obstructive coronary artery disease in patients with zero or low calcium score undergoing 64-slice cardiac multidetector computed tomography for evaluation of a chest pain syndrome

Ref ID 2317 Am J Cardiol pgs: 472 to 475 2007

Study Type Diagnostic

Funding Not reported.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting	
Interventions/ Test/ Factor being investigated	
Comparisons	
Length of Study/ Follow-up	
Outcome measures studied	
Results	
Safety and adverse effects	
Does the study answer the question?	231 low to intermediate risk CAD based on calcium score calcium score patients. Obstructive CAD (greater than 50%) in 9 patients (7%) with calcium score = 0. In patients with a low calcium score (1 to 100) obstructive CAD in 18 patients. Highly significant correlation between calcium score and degree of CAD. Patients with no signs of atherosclerosis from coronary angiography (20 patients) mean total scores of 104 (range 0 to 1459).
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	The results are directly applicable.
Internal Validity	

Question 99: What is the diagnostic utility of non-invasive and invasive tests ifor the evaluation of patients with stable chest pain of suspected cardiac origin.

Grading: 1++ High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias

Sharples L;Hughes V;Crean A;Dyer M;Buxton M;Goldsmith K;Stone D;

Cost-effectiveness of functional cardiac testing in the diagnosis and management of coronary artery disease: a randomised controlled trial. The CECaT trial. [Review] [207 refs]

Ref ID 527 Health Technol Assess pgs: 1 to 115 2007

Study Type Diagnostic

Funding HTA NHS R&D programme.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

The aim of the study was to demonstrate equivalence in exercise time between those randomised to functional tests (SPECT, MRI, stress echo) compared with angiography. The clinical outcome measure was exercise time (Modified Bruce protocol) at 18 months. After initial testing, there were unequivocal results for 98% of angiography, 94% of SPECT (P = 0.05), 78% of MRI (P < 0.001) and 90% of stress echocardiography patients (P < 0.001). Twenty two percent of SPECT patients, 20% of MRI patients and 25% of stress echo patients were not subsequently referred for an angiogram. Positive functional tests were confirmed by positive angiography in 83% of SPECT patients, 89% of MRI patients and 84% of stress echo patients. Negative functional tests were followed by positive angiograms in 31% of SPECT patients, 52% of MRI patients and 48% of stress echo patients tested. Coronary artery bypass graft surgery was performed in 10% of the angiography group, 11% in the MRI group and 13% in both the SPECT and stress echo group. Percutaneous coronary artery intervention was performed in 25% of the angiography group, 18% in the SPECT group and 23% in both the MRI and stress echo group.

At 18 months, there was no clinical difference in total exercise time comparing SPECT and stress echo with angiography. The MRI group had significantly shorter mean total exercise time compared with the angiography group (mean 35 seconds less (P < 0.05) with an upper limit of the CI 1.14 minutes less than in the angiography group). It was concluded that between 20 to 25% patients can avoid invasive testing using functional testing as a gateway to angiography without substantial effects on

	outcome. MRI had the largest number of test failures and in this study had the least practical use in screening patients with suspected CAD, although it had similar outcomes to stress echo.
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	The results are directly applicable to the guideline.
Internal Validity	

Grading: 2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal

Danias PG;Roussakis A;Ioannidis JP;

Diagnostic performance of coronary magnetic resonance angiography as compared against conventional X-ray angiography: a meta-analysis. [Review] [60 refs]

Ref ID 5534 J Am Coll Cardiol pgs: 1867 to 1876 2004

Study Type Diagnostic **Funding** Not stated.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? The SR examined magnetic resonance angiography diagnostic performance at the segment, vessel and patient level, and meta-analysis found that in evaluable segments of native coronary arteries, coronary magnetic resonance angiography has moderately high sensitivity for detecting significant proximal stenosis

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results of the SR are directly applicable to the guideline.

Internal Validity

Heijenbrok-Kal MH;Fleischmann KE;Hunink MG;

Stress echocardiography, stress single-photon-emission computed tomography and electron beam computed tomography for the assessment of coronary artery disease: a meta-analysis of diagnostic performance

Ref ID 1215 Am Heart J pgs: 415 to 423 2007

Study Type Diagnostic

Funding Netherlands Organisation for Scientific Research (program grant 904-66-09) and grant from American Society of Echocardiology

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? Study identifies the sensitivities and specificities of imaging technologies enabling an assessment of diagnostic performance and hence provides appropriate information for the guideline.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results are directly applicable to the guideline.

Internal Validity

Mowatt G;Cummins E;Waugh N;Walker S;Cook J;Jia X;Hillis GS;Fraser C;

Systematic review of the clinical effectiveness and cost-effectiveness of 64-slice or higher computed tomography angiography as an alternative to invasive coronary angiography in the investigation of coronary artery disease

Ref ID 20845 Health Technol Assess pgs: 1 to 143 2008

Study Type Diagnostic

Funding HTA NHS R&D programme.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

This SR and meta-analysis aimed to assess the diagnostic value of 64-slice CT in CAD when compared to conventional CA. Methodology was clearly described. Twenty-one diagnostic studies (n=1286 patients) were included. Levels of analysis included patient (n=18), segment (n=17), left main artery (n=5), left anterior descending (LAD) overall (n=7), LAD proximal (n=5), left circumflex overall (n=7), right coronary artery overall (n=7), stents (n=6) and CABGs (n=4). The median prevalence of CAD across the 21 studies was 58%. A separate SROC curve was derived for each level of analysis e.g. one for patient-level and another for segment level. Sensitivity, specificity, PPV and NPV for patient-based evaluation were 99%, 89%, 93%, and 100%, respectively. For segment-based analysis results were 90%, 97%, 76% and 99%, respectively. The studies were heterogeneous in terms of their participants. In some studies the participants were all suspected CAD, in others they were all known CAD or a mixture of both, or with previous CABG or had LBBB.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

The results of the study are broadly applicable to the guideline, although up to 75% of included studies were not on stable chest pain patients.

Internal Validity

Mowatt G;Vale L;Brazzelli M;Hernandez R;Murray A;Scott N;Fraser- C;McKenzie L;Gemmell H;Hillis G;Metcalfe M;

Systematic review of the effectiveness and cost-effectiveness, and economic evaluation, of myocardial perfusion scintigraphy for the diagnosis and management of angina and myocardial infarction

Ref ID 786 Health Technol Assess pgs: iii to 89 2004

Study Type Diagnostic **Funding** HTA NHS R&D programme.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics	
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	
Comparisons	
Length of Study/ Follow-up	
Outcome measures studied	
Results	
Safety and adverse effects	
Does the study answer the question?	For diagnostic studies the interventions included were SPECT vs. stress ECG, with CA as the reference standard test. In situations where CA would be inappropriate reference standard, clinical follow-up was accepted as the reference standard. For prognostic studies, strategies involving SPECT were compared with strategies that did not. These included: -Stress ECG-SPECT-CA vs Stress ECG-CA -Stress ECG-SPECT vs stress ECG alone -SPECT-CA vs CA alone Stress ECG vs SPECT vs CA -SPECT vs CA -Stress ECG vs SPECT Sensitivity: For studies excluding patients with previous MI: SPECT (n=4) median range 0.92 (0.76-0.93); Stress ECG (n=4) median range 0.66 (0.42-0.85). For studies including patients with previous MI: SPECT (n=10) median range 0.76 (0.63-0.93); Stress ECG (n=10) median range 0.63 (0.44-0.92). Due to heterogeneity among studies no weighted averages were conducted for either SPECT or stress ECG. Specificity:For studies excluding patients with previous MI: SPECT (n=4) median range 0.74 (0.54-0.90); Stress ECG (n=4) median range 0.77 (0.58-0.88). For studies including patients with previous MI: SPECT (n=10) median range 0.65 (0.10-0.80); Stress ECG (n=10) median range 0.77 (0.41-0.80). Due to heterogeneity among studies no weighted averages were conducted for either SPECT or stress ECG Positive LRs: the range of positive LRs was 0.95-8.99 (median 2.33) for SPECT and 1.14-5.60 (median 2.06) for stress ECG. All positive LRs were <10 in both tests. LRs for both tests were calculated for 12 of the 16 studies. For both tests there was significant heterogeneity among positive LRs ($p<0.001$). Negative LRs: Negative LRs ranged from 0.09 to 1.12 (median 0.29) for SPECT and from 0.18 to 0.91 (median 0.57) for stress ECG. Values varied considerably among studies. Two studies showed negative LR for SPECT <0.1 (0.09) and LRs for SPECT were smaller than those for stress ECG.
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	High quality SR. Heterogeneity of studies was taken into consideration in analysis. Prospective and retrospective primary studies of SPECT MPS.

Internal Validity

Nandalur KR;Dwamena BA;Choudhri AF;Nandalur MR;Carlos RC;

Diagnostic performance of stress cardiac magnetic resonance imaging in the detection of coronary artery disease: a meta-analysis. [Review] [44 refs]

Ref ID 1118 J Am Coll Cardiol pgs: 1343 to 1353 2007

Study Type Diagnostic **Funding** Not stated.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? The SR determines the diagnostic utility of cardiac magnetic resonance imaging in the detection of CAD. The SR found that the tests have good sensitivity and specificities, however, the disease prevalence in the identified is studies high, and the performance of the test may not be as sensitive or specific in lower prevalence populations.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The included studies were determining the performance of the test to determine CAD hence the population is directly applicable to the guideline.

Internal Validity

Vanhoenacker PK;Heijenbrok-Kal MH;Van HR;Decramer I;Van-Hoe LR;Wijns W;Hunink MM;

Diagnostic performance of multidetector CT angiography for assessment of coronary artery disease: meta-analysis

Ref ID 10274 Radiology pgs: 419 to 428 2007

Study Type	Diagnostic	**Funding**	Not reported

Number of participant	Study types not specified.
Inclusion/Exclusion Criteria	
Patient Characteristics	
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	
Comparisons	
Length of Study/ Follow-up	
Outcome measures studied	
Results	
Safety and adverse effects	
Does the study answer the question?	This review assessed the diagnostic performance of CT angiography using 4,16, and 64-slice detectors. Six studies of 64-slice CT were included. The study concluded that the newer generation scanners significantly reduced the proportion of non-assessable coronary artery segments. Combined with reduction of the heart rate through the use of beta-blockers, practically all coronary artery segments are assessable. Also, as one increases the size of the unit analysed from coronary arterial segments, to vessels, and to patients, the sensitivity increase, the specificity decreases, , and the overall diagnostic performance decreases. Prevalence of CAD was relatively high in the source populations. The results of this study may therefore not be generalizable to low-prevalence populations.
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	The results are directly applicable to the guideline.
Internal Validity	

Grading: 2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal

Abdulla J;Abildstrom SZ;Gotzsche O;Christensen E;Kober L;Torp-Pedersen C;

64-Multislice detector computed tomography coronary angiography as potential alternative to conventional coronary angiography: A systematic review and meta-analysis

Ref ID 21285 Eur Heart J pgs: 3042 to 3050 2007

Study Type Diagnostic **Funding** Not reported.

Number of participant Type of study not specified.

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? This meta-analyses found that there were differences in sensitivity and specificity values in per-segment vs. per-patient analysis due to calculated higher prevalence of CAD in per-patient data. Sensitivity in per-patient data was 97.5% vs. 86 in per-segment data, in analysis of native coronary arteries. And specificity was 91% vs. 96%, in per-patient and per-segment, respectively.

In general CT demonstrated high accuracy particularly by its high negative predictive values. The accuracy was highest in assessing CABG (96.5) and lowest in stented segments (92%).

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results are directly applicable.

Internal Validity

Geleijnse ML;Krenning BJ;Soliman OI;Nemes A;Galema TW;Ten Cate FJ;

Dobutamine stress echocardiography for the detection of coronary artery disease in women

Ref ID 1961 Am J Cardiol pgs: 714 to 717 2007

Study Type Diagnostic **Funding** Not reported

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? The aim of the SR was to examine the diagnostic accuracy of dobutaine stress echocardiography in women. For the detection of coronary artery disease in women, dobutamine stress echocardiography has reasonable sensitivity and good specificity. Similar sensitivities and specificities were found in studies comparing diagnostic performance in men versus women. Dobutamine stress echochardiology is at least as sensitive as SPECT for the detection of coronary artery disease in women.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The study is directly applicable to the guideline.

Internal Validity

Gianrossi R;Detrano R;Mulvihill D;Lehmann K;Dubach P;Colombo A;McArthur D;Froelicher V;

Exercise-induced ST depression in the diagnosis of coronary artery disease. A meta-analysis. [Review] [171 refs]

Ref ID 17910 Circulation pgs: 87 to 98 1989

Study Type Diagnostic **Funding** Not reported.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? The SR reports that there are wide variabilities in the sensitivities and the specificities in the identified 147 diagnostic studies (mean sensitivity, 68%; range, 23-100%; SD, 16%; and mean specificity, 77%; range,
17-100%; SD, 17%). These differences cannot be explained by publication year, but lower sensitivities are reported in studies with consider additional tests in conjunction with exercise ECG.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results of the study are applicable to the guideline.

Internal Validity

Kimble LP;McGuire DB;Dunbar SB;Fazio S;De A;Weintraub WS;Strickland OS;

Gender differences in pain characteristics of chronic stable angina and perceived physical limitation in patients with coronary artery disease

Ref ID 25387 Pain pgs: 45 to 53 2003

Study Type Cohort **Funding** Not reported

Number of participant 89 men and 39 women. Patients ranged in age from 35 to 86 years, there were 89 men and 39 women, with a mean age of 62.8 SD 11.7 years and 64.1 SD 11.8 years, respectively (not significant)

Inclusion/Exclusion Criteria Patients with a history of CAD, currently stable disease and angina documented by cardiologists from 3 outpatient cardiology clinics. All patients had experienced an episode of chronic stable angina within the previous week. Patients were excluded if they had experienced acute MI, or coronary revascularisation in the previous 6 months. Patients were also exclude if they screened negative on the supplemented Rose questionnaire, or had any active exacerbation of gastrointestinal symptoms

Patient Characteristics Angina patients

Recruitment	Random recruitment from coronary care units
Setting	Outpatient coronary care units
Interventions/ Test/ Factor being investigated	Descriptors of pain and pain intensity
Comparisons	Men versus women
Length of Study/ Follow-up	Not applicable.
Outcome measures studied	Results from pain questionnaires.
Results	Men had been diagnosed with coronary artery disease for longer than women with a mean of 12.9 SD 9.6 years versus 8.8 SD 9.8 (P = 0.030). There was a greater proportion of African American women compared with African American men (43.6% versus 13.5%, respectively, P = 001), more men had a history of acute MI than women (79.8% versus 58.0%, respectively P = 0. 014) and more men had a history of coronary artery bypass graft compared with women (70.8% versus 28.2%, respectively P = 0. 001). There was no difference between men and women in the history of the following; diabetes, hyperlipidaemia, hypertension, acute MI, percutaneous transluminal coronary angioplasty, GI problems. The was no difference in family history of coronary artery disease and current smoking between men and women. Twelve percent of men and 10% of women reported one episode in the previous 7 days, and completed the SF-MPQ based on recall of that episode. Those patients experiencing more than 1 episode chose one specific episode to recall, the most commonly reported reason for choice of episode was that it was the most recent (52.9% men, 36.4% women), and the second reason was that it was the most painful (14.7% men, 18.2% women). The was no difference in the frequency of angina chest pain within in the previous 7 days comparing men with women (mean number of episodes 6.58 SD 7.95 for men and 2.23 SD 3.34). Men reported a mean of 1.7 SD 1.8 days since their last pain episode and women reported a mean of 1.9 SD 1.7 days. For men the most frequent words chosen to describe their angina were aching (74.2%), heavy (70.2%), tiring-exhausting (70.8%) and sharp (56.2%). For women the most frequent words were aching (76.9%), tiring-exhausting (76.9%), heavy (66.7%), hot-burning (61.5%), sharp (53.8%), and fearful (51.3%). Others descriptors that were chosen less frequently (< 35%) were; throbbing, shooting, stabbing, gnawing, splitting and punishing-cruel. Chi square analysis found that women were more likely to describe their angina as hot-burning (P = 0.001) and tender (P = 0.007) compared with men. Women reported significantly higher overall pain intensity as measured by VAS (on a range of 0 to 10 women 6.08 SD 2.7 versus men 5.03 SD 2.4, P = 0.036). No gender differences were found for total sensory or affective intensity scores, or the number of pain words chosen.
Safety and adverse effects	Not applicable
Does the study answer the question?	Somewhat, study identifies that women describe angina pain differently to men.
Effect due to factor in study?	Validated pain questionnaires used so results are likely to be consistent and appropriate descriptors
Consistency of results with other studies?	Consistent
Directly applicable to guideline population?	Stable angina population as defined as screening positive on the supplemented Rose questionnaire, hence directness somewhat limited as chest pain population in guideline.
Internal Validity	Well covered

Meta-analysis of exercise testing to detect coronary artery disease in women.[see comment]

Ref ID 12044 Am J Cardiol pgs: 660 to 666 1999

Study Type Diagnostic

Funding National Institute of Health, Bethesda, Maryland USA. Grant RO1-HL 50772.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question?

The study found that the exercise ECG for women had lower accuracy compared with men, sensitivity 61% versus 70% and specificity 70% versus 77%. There was wide variability in the sensitivities for exercise ECG in women (27% to 91%) and also specificity (46% to 86%).The variability was not associated with the exclusion of patients with baseline ECG changes. Sensitivity and specificity were highly correlated suggesting that investigators may have different threshold for the identification for interpreting a test as positive, despite using the same threshold for interpreting a test as positive. Exercise thallium scanning in women had a higher sensitivity but a lower specificity compared with exercise ECG in women, but the differences were not clinically relevant. Although data was limited in this study exercise echocardiography has higher sensitivities and specificities compared with the other 2 tests.

No information was given on heterogeneity.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population?

The results are directly applicable to the guideline.

Internal Validity

Schuijf JD;Bax JJ;Shaw LJ;de RA;Lamb HJ;van der Wall EE;Wijns W;

Meta-analysis of comparative diagnostic performance of magnetic resonance imaging and multislice computed

tomography for noninvasive coronary angiography.[see comment]. [Review] [57 refs]

Ref ID 3788 Am Heart J pgs: 404 to 411 2006

Study Type Diagnostic

Funding Netherlands Heart Foundation (grant 2002B105).

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? The SR the summary odds ratio for an abnormal multislice CT was elevated 16.9 fols (95% CI 11.0 to 26.1) indicating that an abnormal segment had a 16.9 fold increased odds of significant CAD at cardiac catheterization. In contrast the summary odds ratio was increased 6.4 fold (95% CI 5.0 to 8.3) for MRI. An inverse relationship between diagnostic specificity and CAD prevalence for multislice CT was observed, which remained consistent when controlling for average age and the frequency of men enrolled in each study. No relationship was found for MRI. The authors concluded that MSCT has a significantly better diagnostic accuracy in the detection of CAD compared with MRI.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results of the SR are directly applicable to the guideline.

Internal Validity

Sun Z;Lin C;Davidson R;Dong C;Liao Y;

Diagnostic value of 64-slice CT angiography in coronary artery disease: A systematic review

Ref ID 20820 Eur J Radiol pgs: 78 to 84 2008

Study Type	Diagnostic	**Funding**	Not reported

Number of participant	Type of study not specified. All studies on human subjects were included except case reports and abstracts.
Inclusion/Exclusion Criteria	
Patient Characteristics	
Recruitment	
Setting	
Interventions/ Test/ Factor being investigated	
Comparisons	
Length of Study/ Follow-up	
Outcome measures studied	
Results	
Safety and adverse effects	
Does the study answer the question?	This review answers the question it set out to answer. That is, it provides an estimate of the diagnostic value of 64-slice CT when compared to coronary angiography (CA). It included patients with known CAD and those with suspected CAD (those presenting with chest pain) and as such is useful for our question. However, it would have been even more useful if separate results had been presented for those groups separately. Very little information on the type of studies included was reported. E.g. number of RCTs, cohort studies etc. And no details of the number of patients included in the sensitivity/specificity calculations were reported. However, sensitivity/specificity was reported at patient, vessel and segment level.
Effect due to factor in study?	
Consistency of results with other studies?	
Directly applicable to guideline population?	The results of this SR are directly applicable to the guideline.
Internal Validity	

Grading: 2-	Case–control or cohort studies with a high risk of confounding bias, or chance and a significant risk that the relationship is not causal*

d'Othee Janne B;Siebert U;Cury R;Jadvar H;Dunn EJ;Hoffmann U;

A systematic review on diagnostic accuracy of CT-based detection of significant coronary artery disease. [Review] [60 refs]

Ref ID 177 Eur J Radiol pgs: 449 to 461 2008 Mar

Study Type Diagnostic **Funding** Not stated.

Number of participant

Inclusion/Exclusion Criteria

Patient Characteristics

Recruitment

Setting

Interventions/ Test/ Factor being investigated

Comparisons

Length of Study/ Follow-up

Outcome measures studied

Results

Safety and adverse effects

Does the study answer the question? This study assessed the diagnostic accuracy of multislice CT (4- 8- 16- and 64-slice), although only 5 studies were 64 slice and study sizes ranged from 35 to 84 patients. The main conclusion is that with 64 slice scanners, diagnostic accuracy is high on a per segment basis. Per patient however, this accuracy may be lower in patients with multivessel disease, which may limit the utility of CT in populations at high risk for CAD. Apart from selection bias, this study highlights the fact that most of the studies used two independent investigators to read the scans which might differ from routine clinical practice, and which consequently could limit the applicability of the findings.

Effect due to factor in study?

Consistency of results with other studies?

Directly applicable to guideline population? The results of the study may not be applicable to the guideline as it was poorly conducted. Very little information is given on the type of studies included (RCTs, cohorts). No details of the number of patients included in the meta-analysis are given.

Internal Validity