Chest pain of recent onset: assessment and diagnosis

NICE guideline: short version

Draft for consultation, June 2016

This guideline covers the care and support of adults with chest pain thought to be related to the heart. It gives evidence-based advice on initial assessment, and the tests and treatments that should be offered to people while their condition is being diagnosed.

Who is it for?

- Healthcare professionals in primary and secondary care who assess chest pain and offer tests and treatments during diagnosis.
- People with chest pain of recent onset, their families and carers.

This guideline will update NICE guideline CG95 (published March 2010).

We are currently consulting on updated and new recommendations on the assessment and diagnosis of acute chest pain. A consultation on new and updated recommendations on stable chest pain took place in May 2016. The guideline will be republished in November 2016 with the updated and new recommendations on both acute chest pain and stable chest pain.

For the current consultation, you are invited to comment on the new and updated recommendations marked as:

- **[new 2016]** if the evidence has been reviewed and the recommendation has been added or updated, or
- **[2016]** if the evidence has been reviewed but no change has been made to

the recommended action.

You are also invited to comment on recommendations that NICE proposes to delete from the 2010 guideline.

We have not updated recommendations shaded in grey, and cannot accept comments on them. In some cases, we have made minor wording changes for clarification.

See Update information for a full explanation of what is being updated.

This version of the guideline contains the draft recommendations, context and recommendations for research. Information about how the guideline was developed is on the guideline's page on the NICE website. This includes the guideline committee's discussion and the evidence reviews (in the full guideline), the details of the committee and any declarations of interest.

1

2

Contents

Recommendations

People have the right to be involved in discussions and make informed decisions about their care, as described in your care.

Making decisions using NICE guidelines explains how we use words to show the strength (or certainty) of our recommendations, and has information about prescribing medicines (including off-label use), professional guidelines, standards and laws (including on consent and mental capacity), and safeguarding.

1.1 Providing information for people with chest pain

1.1.1.1 Discuss any concerns people (and where appropriate their family or carer/advocate) may have, including anxiety when the cause of the chest pain is unknown. Correct any misinformation. **[2010]**

1.1.1.2 Offer people a clear explanation of the possible causes of their symptoms and the uncertainties. **[2010]**

1.1.1.3 Clearly explain the options to people at every stage of investigation. Make joint decisions with them and take account of their preferences:

- Encourage people to ask questions.
- Provide repeated opportunities for discussion.
- Explain test results and the need for any further investigations. **[2010]**

1.1.1.4 Provide information about any proposed investigations using everyday, jargon-free language. Include:

- their purpose, benefits and any limitations of their diagnostic accuracy
- duration
- level of discomfort and invasiveness
- risk of adverse events. **[2010]**

1.1.1.5 Offer information about the risks of diagnostic testing, including any radiation exposure. **[2010]**

1.1.1.6 Address any physical or learning difficulties, sight or hearing problems and difficulties with speaking or reading English, which may affect people's understanding of the information offered. **[2010]**

1.1.1.7 Offer information after diagnosis as recommended in the relevant disease management guidelines.[1] **[2010]**

1.1.1.8 Explain if the chest pain is non-cardiac and refer people for further investigation if appropriate. **[2010]**

1.1.1.9 Provide individual advice to people about seeking medical help if they have further chest pain. **[2010]**

1.2 People presenting with acute chest pain

This section of the guideline covers the assessment and diagnosis of people with recent acute chest pain or discomfort, suspected to be caused by an acute coronary syndrome (ACS). The term ACS covers a range of conditions including unstable angina, ST-segment-elevation myocardial infarction (STEMI) and non-ST-segment-elevation myocardial infarction (NSTEMI).

The guideline addresses assessment and diagnosis irrespective of setting, because people present in different ways. Please note that the NICE guideline on unstable angina and NSTEMI (CG94) covers the early management of these conditions once a firm diagnosis has been made and before discharge from hospital.

1.2.1 Initial assessment and referral to hospital

[1] For example, the NICE guidelines on unstable angina and NSTEMI (CG94), generalised anxiety disorder and panic disorder in adults (CG113) and gastro-oesophageal reflux disease and dyspepsia in adults (CG184).

1.2.1.1 Check immediately whether people currently have chest pain. If they are pain free, check when their last episode of pain was, particularly if they have had pain in the last 12 hours. **[2010]**

1.2.1.2 Determine whether the chest pain may be cardiac and therefore whether this guideline is relevant, by considering:

- the history of the chest pain
- the presence of cardiovascular risk factors
- history of ischaemic heart disease and any previous treatment
- previous investigations for chest pain. **[2010]**

1.2.1.3 Initially assess people for any of the following symptoms, which may indicate an ACS:

- pain in the chest and/or other areas (for example, the arms, back or jaw) lasting longer than 15 minutes
- chest pain associated with nausea and vomiting, marked sweating, breathlessness, or particularly a combination of these
- chest pain associated with haemodynamic instability
- new onset chest pain, or abrupt deterioration in previously stable angina, with recurrent chest pain occurring frequently and with little or no exertion, and with episodes often lasting longer than 15 minutes. **[2010]**

1.2.1.4 Do not use people's response to glyceryl trinitrate (GTN) to make a diagnosis. **[2010]**

1.2.1.5 Do not assess symptoms of an ACS differently in men and women. Not all people with an ACS present with central chest pain as the predominant feature. **[2010]**

1.2.1.6 Do not assess symptoms of an ACS differently in ethnic groups. There are no major differences in symptoms of an ACS among different ethnic groups. **[2010]**

1.2.1.7 Refer people to hospital as an emergency if an ACS is suspected (see recommendation 1.2.1.3) and:

- they currently have chest pain or
- they are currently pain free, but had chest pain in the last 12 hours, and a resting 12-lead ECG is abnormal or not available. **[2010]**

1.2.1.8 If an ACS is suspected (see recommendation 1.2.1.3) and there are no reasons for emergency referral, refer people for urgent same-day assessment if:

- they had chest pain in the last 12 hours, but are now pain free with a normal resting 12-lead ECG or
- the last episode of pain was 12–72 hours ago. **[2010]**

1.2.1.9 Refer people for assessment in hospital if an ACS is suspected (see recommendation 1.2.1.3) and:

- the pain has resolved and
- there are signs of complications such as pulmonary oedema.

Use clinical judgement to decide whether referral should be as an emergency or urgent same-day assessment. **[2010]**

1.2.1.10 If a recent ACS is suspected in people whose last episode of chest pain was more than 72 hours ago and who have no complications such as pulmonary oedema:

- carry out a detailed clinical assessment (see recommendations 1.2.4.2 and 1.2.4.3)
- confirm the diagnosis by resting 12-lead ECG and blood troponin level
- take into account the length of time since the suspected ACS when interpreting the troponin level.

Use clinical judgement to decide whether referral is necessary and how urgent this should be. **[2010]**

1.2.1.11 Refer people to hospital as an emergency if they have a recent (confirmed or suspected) ACS and develop further chest pain. **[2010]**

1.2.1.12 When an ACS is suspected, start management immediately in the order appropriate to the circumstances (see section 1.2.3) and take a resting 12-lead ECG (see section 1.2.2). Take the ECG as soon as possible, but do not delay transfer to hospital. **[2010]**

1.2.1.13 If an ACS is not suspected, consider other causes of the chest pain, some of which may be life-threatening (see recommendations 1.2.6.5, 1.2.6.7 and 1.2.6.8). **[2010]**

1.2.2 Resting 12-lead ECG

1.2.2.1 Take a resting 12-lead ECG as soon as possible. When people are referred, send the results to hospital before they arrive if possible. Recording and sending the ECG should not delay transfer to hospital. **[2010]**

1.2.2.2 Follow local protocols for people with a resting 12-lead ECG showing regional ST-segment elevation or presumed new left bundle branch block (LBBB) consistent with an acute STEMI until a firm diagnosis is made. Continue to monitor (see recommendation 1.2.3.4). **[2010]**

1.2.2.3 Follow the NICE guideline on unstable angina and NSTEMI (CG94) for people with a resting 12-lead ECG showing regional ST-segment depression or deep T wave inversion suggestive of a NSTEMI or unstable angina until a firm diagnosis is made. Continue to monitor (see recommendation 1.2.3.4). **[2010]**

1.2.2.4 Even in the absence of ST-segment changes, have an increased suspicion of an ACS if there are other changes in the resting 12-

lead ECG, specifically Q waves and T wave changes. Consider following the NICE guideline on unstable angina and NSTEMI (CG94) if these conditions are likely. Continue to monitor (see recommendation 1.2.3.4). **[2010]**

1.2.2.5 Do not exclude an ACS when people have a normal resting 12-lead ECG. **[2010]**

1.2.2.6 If a diagnosis of ACS is in doubt, consider:

- taking serial resting 12-lead ECGs
- reviewing previous resting 12-lead ECGs
- recording additional ECG leads.

Use clinical judgement to decide how often this should be done. Note that the results may not be conclusive. **[2010]**

1.2.2.7 Obtain a review of resting 12-lead ECGs by a healthcare professional qualified to interpret them as well as taking into account automated interpretation. **[2010]**

1.2.2.8 If clinical assessment (as described in recommendation 1.2.1.10) and a resting 12-lead ECG make a diagnosis of ACS less likely, consider other acute conditions. First consider those that are life-threatening such as pulmonary embolism, aortic dissection or pneumonia. Continue to monitor (see recommendation 1.2.3.4). **[2010]**

1.2.3 Immediate management of a suspected acute coronary syndrome

Management of ACS should start as soon as it is suspected, but should not delay transfer to hospital. The recommendations in this section should be carried out in the order appropriate to the circumstances.

1.2.3.1 Offer pain relief as soon as possible. This may be achieved with GTN (sublingual or buccal), but offer intravenous opioids such as

morphine, particularly if an acute myocardial infarction (MI) is suspected. **[2010]**

1.2.3.2 Offer people a single loading dose of 300 mg aspirin as soon as possible unless there is clear evidence that they are allergic to it.

If aspirin is given before arrival at hospital, send a written record that it has been given with the person.

Only offer other antiplatelet agents in hospital. Follow appropriate guidance (the NICE guideline on unstable angina and NSTEMI or local protocols for STEMI). **[2010]**

1.2.3.3 Do not routinely administer oxygen, but monitor oxygen saturation using pulse oximetry as soon as possible, ideally before hospital admission. Only offer supplemental oxygen to:

- people with oxygen saturation (SpO2) of less than 94% who are not at risk of hypercapnic respiratory failure, aiming for SpO2 of 94–98%
- people with chronic obstructive pulmonary disease who are at risk of hypercapnic respiratory failure, to achieve a target SpO2 of 88–92% until blood gas analysis is available. **[2010]**

1.2.3.4 Monitor people with acute chest pain, using clinical judgement to decide how often this should be done, until a firm diagnosis is made. This should include:

- exacerbations of pain and/or other symptoms
- pulse and blood pressure
- heart rhythm
- oxygen saturation by pulse oximetry
- repeated resting 12-lead ECGs and
- checking pain relief is effective. **[2010]**

1.2.3.5 Manage other therapeutic interventions using appropriate guidance (the NICE guideline on unstable angina and NSTEMI or local protocols for STEMI). **[2010]**

1.2.4 Assessment in hospital for people with a suspected acute coronary syndrome

1.2.4.1 Take a resting 12-lead ECG and a blood sample for high-sensitivity troponin I or T measurement (see section 1.2.5) on arrival in hospital. **[2010, amended 2016]**

1.2.4.2 Carry out a physical examination to determine:

- haemodynamic status
- signs of complications, for example pulmonary oedema, cardiogenic shock and
- signs of non-coronary causes of acute chest pain, such as aortic dissection. **[2010]**

1.2.4.3 Take a detailed clinical history unless a STEMI is confirmed from the resting 12-lead ECG (that is, regional ST-segment elevation or presumed new LBBB). Record:

- the characteristics of the pain
- other associated symptoms
- any history of cardiovascular disease
- any cardiovascular risk factors and
- details of previous investigations or treatments for similar symptoms of chest pain. **[2010]**

1.2.5 Use of biochemical markers for diagnosis of an acute coronary syndrome

1.2.5.1 Do not use high-sensitivity troponin tests for people in whom ACS is not suspected. **[new 2016]**

1.2.5.2 For people at high or moderate risk of MI (as indicated by a validated tool), perform high-sensitivity troponin tests as

recommended in the NICE diagnostics guidance on myocardial infarction (DG15). **[new 2016]**

1.2.5.3 For people at low risk of MI (as indicated by a validated tool):

- perform a second high-sensitivity troponin test as recommended in the NICE diagnostics guidance on myocardial infarction (DG15) if the first troponin test at presentation is positive
- consider performing a single high-sensitivity troponin test only at presentation to rule out NSTEMI if the first troponin test is below the lower limit of detection (negative). **[new 2016]**

1.2.5.4 Do not use biochemical markers such as naturetic peptides and high-sensitivity C-reactive protein to diagnose an ACS. **[2010]**

1.2.5.5 Do not use biochemical markers of myocardial ischaemia (such as ischaemia-modified albumin) as opposed to markers of necrosis when assessing people with acute chest pain. **[2010]**

1.2.5.6 When interpreting high-sensitivity troponin measurements, take into account:

- the clinical presentation
- the time from onset of symptoms
- the resting 12-lead ECG findings
- the pre-test probability of NSTEMI
- the length of time since the suspected ACS
- the probability of chronically elevated troponin levels in some people
- that 99th percentile thresholds for troponin I and T may differ between sexes. **[2010, amended 2016]**

1.2.6 Making a diagnosis

1.2.6.1 When diagnosing MI, use the universal definition of myocardial infarction[2]. This is the detection of rise and/or fall of cardiac biomarkers values [preferably cardiac troponin (cTn)] with at least one value above the 99th percentile of the upper reference limit and at least one of the following:

- symptoms of ischaemia
- new or presumed new significant ST-segment-T wave(ST-T) changes or new left bundle branch block (LBBB)
- development of pathological Q waves in the ECG
- imaging evidence of new loss of viable myocardium or new regional wall motion abnormality[3].
- identification of an intracoronary thrombus by angiography.

[2010, amended 2016]

1.2.6.2 When a raised troponin level is detected in people with a suspected ACS, reassess to exclude other causes for raised troponin (for example, myocarditis, aortic dissection or pulmonary embolism) before confirming the diagnosis of ACS. **[2010]**

1.2.6.3 When a raised troponin level is detected in people with a suspected ACS, follow the appropriate guidance (the NICE guideline on unstable angina and NSTEMI or local protocols for STEMI) until a firm diagnosis is made. Continue to monitor (see recommendation 1.2.3.4). **[2010]**

1.2.6.4 When a diagnosis of ACS is confirmed, follow the appropriate guidance (the NICE guideline on unstable angina and NSTEMI or local protocols for STEMI). **[2010]**

[2] Thygesen K, Alpert JS, Jaffe AS et al. (2012) Third universal definition of myocardial infarction. Circulation 126: 2020–5. The definition also includes post-mortem diagnosis in the diagnostic classification.

[3] The Guideline Development Group did not review the evidence for the use of imaging evidence of new loss of viable myocardium or new regional wall motion abnormality in the diagnosis of MI, but recognised that it was included as a criterion in the universal definition of MI. The Guideline Development Group recognised that it could be used, but would not be done routinely when there were symptoms of ischaemia and ECG changes.

1.2.6.5 Reassess people with chest pain without raised troponin levels and no acute resting 12-lead ECG changes to determine whether their chest pain is likely to be cardiac.

If myocardial ischaemia is suspected, follow the recommendations on stable chest pain in this guideline (see section 1.3). Use clinical judgement to decide on the timing of any further diagnostic investigations. **[2010, amended 2016]**

1.2.6.6 Do not routinely offer non-invasive imaging or exercise ECG in the initial assessment of acute cardiac chest pain. **[new 2016]**

1.2.6.7 Only consider early chest computed tomography (CT) to rule out other diagnoses such as pulmonary embolism or aortic dissection, not to diagnose ACS. **[2010]**

1.2.6.8 Consider a chest X-ray to help exclude complications of ACS such as pulmonary oedema, or other diagnoses such as pneumothorax or pneumonia. **[2010]**

1.2.6.9 If an ACS has been excluded at any point in the care pathway, but people have risk factors for cardiovascular disease, follow the appropriate guidance, for example the NICE guidelines on cardiovascular disease and hypertension in adults. **[2010]**

1.3 People presenting with stable chest pain

This section of the guideline addresses the assessment and diagnosis of intermittent stable chest pain in people with suspected stable angina.

Angina is usually caused by coronary artery disease (CAD). Making a diagnosis of stable angina caused by CAD in people with chest pain is not always straightforward, and the recommendations aim to guide and support clinical judgement. Clinical assessment alone may be sufficient to confirm or exclude a diagnosis of stable angina, but when there is uncertainty, additional diagnostic testing (functional or anatomical testing) guided by the estimates of likelihood of coronary artery disease in table 1, is required.

1.3.1.1 Diagnose stable angina based on one of the following:

- clinical assessment alone or
- clinical assessment plus diagnostic testing (that is, anatomical testing for obstructive CAD and/or functional testing for myocardial ischaemia). **[2010]**

1.3.2 Clinical assessment

1.3.2.1 Take a detailed clinical history documenting:

- the age and sex of the person
- the characteristics of the pain, including its location, radiation, severity, duration and frequency, and factors that provoke and relieve the pain
- any associated symptoms, such as breathlessness
- any history of angina, MI, coronary revascularisation, or other cardiovascular disease and
- any cardiovascular risk factors. **[2010]**

1.3.2.2 Carry out a physical examination to:

- identify risk factors for cardiovascular disease
- identify signs of other cardiovascular disease
- identify non-coronary causes of angina (for example, severe aortic stenosis, cardiomyopathy) and
- exclude other causes of chest pain. **[2010]**

1.3.3 Making a diagnosis based on clinical assessment

1.3.3.1 Anginal pain is:

- constricting discomfort in the front of the chest, or in the neck, shoulders, jaw, or arms
- precipitated by physical exertion
- relieved by rest or GTN within about 5 minutes.

Use clinical assessment and the typicality of anginal pain features listed below to estimate the likelihood of CAD (see Table 1):

- Three of the features above are defined as typical angina.
- Two of the three features above are defined as atypical angina.
- One or none of the features above are defined as non-anginal chest pain. **[2010]**

Table 1: Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex and risk factors

	Non-anginal chest pain				Atypical angina				Typical angina			
	Men		Women		Men		Women		Men		Women	
Age (years)	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi
35	3	35	1	19	8	59	2	39	30	88	10	78
45	9	47	2	22	21	70	5	43	51	92	20	79
55	23	59	4	25	45	79	10	47	80	95	38	82
65	49	69	9	29	71	86	20	51	93	97	56	84

For men older than 70 with atypical or typical symptoms, assume an estimate > 90%.

For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.

Values are per cent of people at each mid-decade age with significant coronary artery disease (CAD).4

Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).

Lo = Low risk = none of these three.

The shaded area represents people with symptoms of non-anginal chest pain, who would not be investigated for stable angina routinely.

Note:

These results are likely to overestimate CAD in primary care populations.

If there are resting ECG ST-T changes or Q waves, the likelihood of CAD is higher in each cell of the table.

1.3.3.2 Do not define typical and atypical features of anginal chest pain and non-anginal chest pain differently in men and women. **[2010]**

[4] Adapted from Pryor DB, Shaw L, McCants CB et al. (1993) Value of the history and physical in identifying patients at increased risk for coronary artery disease. Annals of Internal Medicine 118(2):81–90.

1.3.3.3 Do not define typical and atypical features of anginal chest pain and non-anginal chest pain differently in ethnic groups. **[2010]**

1.3.3.4 Take the following factors, which make a diagnosis of stable angina more likely, into account when estimating people's likelihood of angina:

- increasing age
- whether the person is male
- cardiovascular risk factors including:
  - a history of smoking
  - diabetes
  - hypertension
  - dyslipidaemia
  - family history of premature CAD
  - other cardiovascular disease
- history of established CAD, for example previous MI, coronary revascularisation. **[2010]**

1.3.3.5 If people have features of typical angina based on clinical assessment and their estimated likelihood of CAD is greater than 90% (see Table 1), further diagnostic investigation is unnecessary. Manage as angina. **[2010]**

1.3.3.6 Unless clinical suspicion is raised based on other aspects of the history and risk factors, exclude a diagnosis of stable angina if the pain is non-anginal (see recommendation 1.3.3.1). Other features which make a diagnosis of stable angina unlikely are when the chest pain is:

- continuous or very prolonged and/or
- unrelated to activity and/or
- brought on by breathing in and/or
- associated with symptoms such as dizziness, palpitations, tingling or difficulty swallowing.

Consider causes of chest pain other than angina (such as gastrointestinal or musculoskeletal pain). **[2010]**

1.3.3.7 If the estimated likelihood of CAD is less than 10% (see Table 1), first consider causes of chest pain other than angina caused by CAD. **[2010]**

1.3.3.8 Consider investigating other causes of angina, such as hypertrophic cardiomyopathy, in people with typical angina-like chest pain and a low likelihood of CAD (estimated at less than 10%). **[2010]**

1.3.3.9 Arrange blood tests to identify conditions which exacerbate angina, such as anaemia, for all people being investigated for stable angina. **[2010]**

1.3.3.10 Only consider chest X-ray if other diagnoses, such as a lung tumour, are suspected. **[2010]**

1.3.3.11 If a diagnosis of stable angina has been excluded at any point in the care pathway, but people have risk factors for cardiovascular disease, follow the appropriate guidance, for example 'Lipid modification' (NICE clinical guideline 67), 'Hypertension' (NICE clinical guideline 34). **[2010]**

1.3.3.12 For people in whom stable angina cannot be diagnosed or excluded on the basis of the clinical assessment alone, take a resting 12-lead ECG as soon as possible after presentation. **[2010]**

1.3.3.13 Do not rule out a diagnosis of stable angina on the basis of a normal resting 12-lead ECG. **[2010]**

1.3.3.14 A number of changes on a resting 12-lead ECG are consistent with CAD and may indicate ischaemia or previous infarction. These include:

- pathological Q waves in particular

- LBBB
- ST-segment and T wave abnormalities (for example, flattening or inversion).

Note that the results may not be conclusive.

Consider any resting 12-lead ECG changes together with people's clinical history and risk factors. **[2010]**

1.3.3.15 For people with confirmed CAD (for example, previous MI, revascularisation, previous angiography) in whom stable angina cannot be diagnosed or excluded based on clinical assessment alone, see recommendation 1.3.4.8 about functional testing. **[2010]**

1.3.3.16 In people without confirmed CAD, in whom stable angina cannot be diagnosed or excluded based on clinical assessment alone, estimate the likelihood of CAD (see Table 1). Take the clinical assessment and the resting 12-lead ECG into account when making the estimate. Arrange further diagnostic testing as follows:

- If the estimated likelihood of CAD is 61–90%, offer invasive coronary angiography as the first-line diagnostic investigation if appropriate (see recommendations 1.3.4.4 and 1.3.4.5).
- If the estimated likelihood of CAD is 30–60%, offer functional imaging as the first-line diagnostic investigation (see recommendation 1.3.4.6).
- If the estimated likelihood of CAD is 10–29%, offer CT calcium scoring as the first-line diagnostic investigation (see recommendation 1.3.4.7). **[2010]**

1.3.3.17 Consider aspirin only if the person's chest pain is likely to be stable angina, until a diagnosis is made. Do not offer additional aspirin if there is clear evidence that people are already taking aspirin regularly or are allergic to it. **[2010]**

1.3.3.18 Follow local protocols for stable angina while waiting for the results of investigations if symptoms are typical of stable angina. **[2010]**

1.3.4 Diagnostic testing for people in whom stable angina cannot be diagnosed or excluded by clinical assessment alone

This guideline addresses only the diagnostic value of tests for stable angina. The prognostic value of these tests was not considered.

The Guideline Development Group carefully considered the risk of radiation exposure from diagnostic tests. It discussed that the risk needs to be considered in the context of radiation exposure from everyday life, the substantial intrinsic risk that a person will develop cancer during their lifetime and the potential risk of failing to make an important diagnosis if a particular test is not performed. The commonly accepted estimate of the additional lifetime risk of dying from cancer with 10 millisieverts of radiation is 1 in 2000. The Guideline Development Group emphasised that the recommendations in this guideline are to make a diagnosis of chest pain, not to screen for CAD. Most people diagnosed with non-anginal chest pain after clinical assessment need no further diagnostic testing. However in a very small number of people, there are remaining concerns that the pain could be ischaemic, in which case the risk of undiagnosed angina outweighs the risk of any potential radiation exposure.

1.3.4.1 Include the typicality of anginal pain features and the estimate of CAD likelihood (see recommendation 1.3.3.16) in all requests for diagnostic investigations and in the person's notes. **[2010]**

1.3.4.2 Use clinical judgement and take into account people's preferences and comorbidities when considering diagnostic testing. **[2010]**

1.3.4.3 Take into account people's risk from radiation exposure when considering which diagnostic test to use. **[2010]**

1.3.4.4 For people with chest pain in whom stable angina cannot be diagnosed or excluded by clinical assessment alone and who have an estimated likelihood of CAD of 61–90% (see recommendation 1.3.3.16), offer invasive coronary angiography after clinical assessment and a resting 12-lead ECG if:

- coronary revascularisation is being considered and
- invasive coronary angiography is clinically appropriate and acceptable to the person. **[2010]**

1.3.4.5 For people with chest pain in whom stable angina cannot be diagnosed or excluded by clinical assessment alone and who have an estimated likelihood of CAD of 61–90% (see recommendation 1.3.3.16), offer non-invasive functional imaging after clinical assessment and a resting 12-lead ECG if:

- coronary revascularisation is not being considered or
- invasive coronary angiography is not clinically appropriate or acceptable to the person. **[2010]**

1.3.4.6 For people with chest pain in whom stable angina cannot be diagnosed or excluded by clinical assessment alone and who have an estimated likelihood of CAD of 30–60% (see recommendation 1.3.3.16), offer non-invasive functional imaging for myocardial ischaemia. See section 1.3.6 for further guidance on non-invasive functional testing. **[2010]**

1.3.4.7 For people with chest pain in whom stable angina cannot be diagnosed or excluded by clinical assessment alone and who have an estimated likelihood of CAD of 10–29% (see recommendation 1.3.3.16) offer CT calcium scoring. If the calcium score is:

- zero, consider other causes of chest pain
- 1–400, offer 64-slice (or above) CT coronary angiography
- greater than 400, offer invasive coronary angiography. If this is not clinically appropriate or acceptable to the person and revascularisation is not being considered, offer non-invasive functional imaging. See section 1.3.6 for further guidance on non-invasive functional testing. **[2010]**

1.3.4.8 For people with confirmed CAD (for example, previous MI, revascularisation, previous angiography), offer non-invasive

functional testing when there is uncertainty about whether chest pain is caused by myocardial ischaemia. See section 1.3.6 for further guidance on non-invasive functional testing. An exercise ECG may be used instead of functional imaging. **[2010]**

1.3.5 Additional diagnostic investigations

1.3.5.1 Offer non-invasive functional imaging (see section 1.3.6) for myocardial ischaemia if invasive coronary angiography or 64-slice (or above) CT coronary angiography has shown CAD of uncertain functional significance. **[2010]**

1.3.5.2 Offer invasive coronary angiography as a second-line investigation when the results of non-invasive functional imaging are inconclusive. **[2010]**

1.3.6 Use of non-invasive functional testing for myocardial ischaemia

1.3.6.1 When offering non-invasive functional imaging for myocardial ischaemia use:

- myocardial perfusion scintigraphy with single photon emission computed tomography (MPS with SPECT) or
- stress echocardiography or
- first-pass contrast-enhanced magnetic resonance (MR) perfusion or
- MR imaging for stress-induced wall motion abnormalities.

Take account of locally available technology and expertise, the person and their preferences, and any contraindications when deciding on the imaging method. [This recommendation updates and replaces recommendation 1.1 of 'Myocardial perfusion scintigraphy for the diagnosis and management of angina and myocardial infarction' (NICE technology appraisal guidance 73)]. **[2010]**

1.3.6.2 Use adenosine, dipyridamole or dobutamine as stress agents for MPS with SPECT and adenosine or dipyridamole for first-pass contrast-enhanced MR perfusion. **[2010]**

1.3.6.3 Use exercise or dobutamine for stress echocardiography or MR imaging for stress-induced wall motion abnormalities. **[2010]**

1.3.6.4 Do not use MR coronary angiography for diagnosing stable angina. **[2010]**

1.3.6.5 Do not use exercise ECG to diagnose or exclude stable angina for people without known CAD. **[2010]**

1.3.7 Making a diagnosis following investigations

1.3.7.1 Confirm a diagnosis of stable angina and follow local guidelines for angina when:

- significant CAD (see box 1) is found during invasive or 64-slice (or above) CT coronary angiography and/or
- reversible myocardial ischaemia is found during non-invasive functional imaging. **[2010]**

Box 1 Definition of significant coronary artery disease

Significant coronary artery disease (CAD) found during CTcoronary angiography is ≥ 70% diameter stenosis of at least one major epicardial artery segment or ≥ 50% diameter stenosis in the left main coronary artery:

<u>Factors intensifying ischaemia</u>

Such factors allow less severe lesions (for example ≥ 50%) to produce angina:

- Reduced oxygen delivery: anaemia, coronary spasm
- Increased oxygen demand: tachycardia, left ventricular hypertrophy
- Large mass of ischaemic myocardium: proximally located lesions

- Longer lesion length.

Factors reducing ischaemia which may render severe lesions (≥ 70%) asymptomatic

- Well-developed collateral supply
- Small mass of ischaemic myocardium: distally located lesions, old infarction in the territory of coronary supply. **[2016]**

1.3.7.2 Investigate other causes of chest pain when:

- significant CAD (see box 1) is not found during invasive coronary angiography or 64-slice (or above) CT coronary angiography and/or
- reversible myocardial ischaemia is not found during non-invasive functional imaging or
- the calcium score is zero. **[2010]**

1.3.7.3 Consider investigating other causes of angina, such as hypertrophic cardiomyopathy or syndrome X, in people with typical angina-like chest pain if investigation excludes flow-limiting disease in the epicardial coronary arteries. **[2010]**

Terms used in this guideline

Chest pain

The term 'chest pain' is used throughout the guideline to mean chest pain or discomfort.

Putting this guideline into practice

NICE has produced tools and resources to help you put this guideline into practice.

Putting recommendations into practice can take time. How long may vary from guideline to guideline, and depends on how much change in practice or

services is needed. Implementing change is most effective when aligned with local priorities.

Changes recommended for clinical practice that can be done quickly – like changes in prescribing practice – should be shared quickly. This is because healthcare professionals should use guidelines to guide their work – as is required by professional regulating bodies such as the General Medical and Nursing and Midwifery Councils.

Changes should be implemented as soon as possible, unless there is a good reason for not doing so (for example, if it would be better value for money if a package of recommendations were all implemented at once).

Different organisations may need different approaches to implementation, depending on their size and function. Sometimes individual practitioners may be able to respond to recommendations to improve their practice more quickly than large organisations.

Here are some pointers to help organisations put NICE guidelines into practice:

1. **Raise awareness** through routine communication channels, such as email or newsletters, regular meetings, internal staff briefings and other communications with all relevant partner organisations. Identify things staff can include in their own practice straight away.

2. **Identify a lead** with an interest in the topic to champion the guideline and motivate others to support its use and make service changes, and to find out any significant issues locally.

3. **Carry out a baseline assessment** against the recommendations to find out whether there are gaps in current service provision.

4. **Think about what data you need to measure improvement** and plan how you will collect it. You may want to work with other health and social care organisations and specialist groups to compare current practice with the

recommendations. This may also help identify local issues that will slow or prevent implementation.

5. **Develop an action plan**, with the steps needed to put the guideline into practice, and make sure it is ready as soon as possible. Big, complex changes may take longer to implement, but some may be quick and easy to do. An action plan will help in both cases.

6. **For very big changes** include milestones and a business case, which will set out additional costs, savings and possible areas for disinvestment. A small project group could develop the action plan. The group might include the guideline champion, a senior organisational sponsor, staff involved in the associated services, finance and information professionals.

7. **Implement the action plan** with oversight from the lead and the project group. Big projects may also need project management support.

8. **Review and monitor** how well the guideline is being implemented through the project group. Share progress with those involved in making improvements, as well as relevant boards and local partners.

NICE provides a comprehensive programme of support and resources to maximise uptake and use of evidence and guidance. See our into practice pages for more information.

Also see Leng G, Moore V, Abraham S, editors (2014) Achieving high quality care – practical experience from NICE. Chichester: Wiley.

Context

Conditions causing chest pain or discomfort, such as an acute coronary syndrome or angina, have a potentially poor prognosis, emphasising the importance of prompt and accurate diagnosis. Treatments are available to improve symptoms and prolong life, hence the need for this guideline.

This guideline covers the assessment and diagnosis of people with recent onset chest pain or discomfort of suspected cardiac origin. In deciding

whether chest pain may be cardiac and therefore whether this guideline is relevant, a number of factors should be taken into account. These include the person's history of chest pain, their cardiovascular risk factors, history of ischaemic heart disease and any previous treatment, and previous investigations for chest pain.

For pain that is suspected to be cardiac, there are two separate diagnostic pathways presented in the guideline. The first is for people with acute chest pain and a suspected acute coronary syndrome, and the second is for people with intermittent stable chest pain in whom stable angina is suspected. The guideline includes how to determine whether myocardial ischaemia is the cause of the chest pain and how to manage the chest pain while people are being assessed and investigated.

As far as possible, the recommendations in this guideline have been listed in the order in which they will be carried out and follow the diagnostic pathways. But, as there are many permutations at each decision point, it has been necessary to include frequent cross-referencing to avoid repeating recommendations several times.

This guideline does not cover the diagnosis and management of chest pain that is unrelated to the heart (for example, traumatic chest wall injury, herpes zoster infection) when myocardial ischaemia has been excluded. The guideline also recognises that in people with a prior diagnosis of coronary artery disease, chest pain or discomfort is not necessarily cardiac.

The guideline will assume that prescribers will use a drug's summary of product characteristics to inform decisions made with individual patients.

More information

To find out what NICE has said on topics related to this guideline, see our web page on cardiovascular conditions.

Recommendations for research

In 2010, the guideline committee made the following recommendations for research. The committee's full set of research recommendations is detailed in the full guideline.

1 Cost-effectiveness of multislice CT coronary angiography for ruling out obstructive CAD in people with troponin-negative acute coronary syndromes

Is multislice CT coronary angiography a cost-effective first-line test for ruling out obstructive CAD in people with suspected troponin-negative acute coronary syndromes? **[2010]**

Why this is important

Current European Society of Cardiology guidelines state that in troponin-negative ACS, with no ST-segment change on the ECG, 'a stress test is recommended… in patients with significant ischaemia during the stress test, coronary angiography and subsequent revascularisation should be considered'. Yet stress testing has relatively low sensitivity and specificity for diagnosing CAD in this group of people. Therefore a significant proportion of at-risk people are missed while others with normal coronary arteries are subjected to an unnecessary invasive coronary angiogram. Multislice CT coronary angiography is highly sensitive and provides a potentially useful means for early rule-out of CAD in troponin-negative acute coronary disease. We need to know whether it is cost effective compared with exercise ECG as a first test in the diagnostic work up of this group.

2 Refining the use of telephone advice in people with chest pain

In what circumstances should telephone advice be given to people calling with chest pain? Is the appropriateness influenced by age, sex or symptoms? **[2010]**

Why this is important

The telephone is a common method of first contact with healthcare services, and produces a near uniform emergency response to chest pain symptoms. Such a response has considerable economic, social and human costs. Research should be conducted to clarify if an emergency response in all circumstances is appropriate, or if there are identifiable factors such as age, sex, or associated symptoms that would allow a modified response and a more appropriate use of resources.

3 Establishing a national registry for people who are undergoing initial assessment for stable angina

Can a national registry of people presenting with suspected angina be established to allow cohort analysis of treatments, investigations and outcomes in this group? Such a registry would provide a vital resource for a range of important research projects, including:

- development and validation of a new score for assessing the pre-test probability of disease, addressing outstanding uncertainties in the estimation of the pre-test probability of CAD based on simple measures made at initial assessment (history, examination, routine bloods, resting 12-lead ECG)
- assessment of the extent to which new circulating biomarkers add additional information to measures made at initial assessment
- provision of a framework for trial recruitment without significant work-up bias allowing evaluation of the diagnostic and prognostic test performance of CT-based, MR, echocardiography, and radionuclide technologies. **[2010]**

Why this is important

A national prospective registry of consecutive people with suspected stable angina before initial diagnostic testing does not currently exist in the UK or in any other country. Establishing such a registry would offer the following methodological strengths; statistical size, representative patients without work-up bias, contemporary data. This would overcome key problems in much of the existing evidence base.

Accurate assessment of pre-test likelihood of coronary disease is needed to inform the cost-effective choice of investigative technologies such as CT coronary calcium scoring for people with chest pain that may be caused by myocardial ischaemia. The data on which pre-test likelihood is based date from 1979 in a US population and may not be applicable to contemporary UK populations. There remain continuing uncertainties about the initial assessment of people with suspected stable angina. For example, the possible contributions of simple clinical measures such as body mass index, routine blood markers (for example, haemoglobin) or novel circulating biomarkers to estimates of the pre-test likelihood of CAD are not known and require further assessment in the whole population and in predefined subgroups including ethnic minorities.

4 Cost-effectiveness of multislice CT coronary angiography compared with functional testing in the diagnosis of angina

What is the clinical and cost effectiveness of multislice CT coronary angiography compared with functional testing in the diagnosis of angina in a population of people with stable chest pain who have a moderate (30–60%) pre-test likelihood of CAD? **[2010]**

Why this is important

Multislice CT coronary angiography has developed rapidly in recent years. Published reviews have shown it to be highly effective in the diagnosis of anatomically significant CAD, and costing data indicate that tests can be run at a relatively low cost. However, questions remain about the ability of multislice CT coronary angiography to accurately identify stenoses of functional significance (that is, those that are sufficient to cause angina) in people with stable chest pain. This is especially true for people with a moderate pre-test likelihood of significant CAD.

Cost-effectiveness modelling to date has used the diagnosis of CAD as a short-term outcome, and as such inexpensive anatomical tests like multislice CT coronary angiography fare better than functional testing strategies such as MPS with SPECT, stress perfusion MR imaging and stress echocardiography.

Because the diagnosis of angina is the true outcome of interest, health economic modelling is needed to evaluate diagnostic technologies on their ability to diagnose stable angina.

5 Information about presenting and explaining tests

All people presenting with chest pain will need to decide whether to accept the diagnostic and care pathways offered. How should information about the diagnostic pathway and the likely outcomes, risks and benefits, with and without treatment, be most effectively presented to particular groups of people, defined by age, ethnicity and sex? **[2010]**

Why this is important

Methods of communication (both the content and delivery) will be guided by current evidence-based best practice. Controlled trials should be conducted based on well-constructed randomised controlled clinical trials comparing the effects of different methods of communication on the understanding of the person with chest pain. Such studies might consider a number of delivery mechanisms, including advice and discussion with a clinician or a specialist nurse as well as specific information leaflets or visual data.

Any trials should also investigate the feasibility of introducing a suggested guideline protocol to be used with all people presenting with chest pain when faced with options concerning their clinical pathway.

Only by clearly explaining and then discussing the proposed diagnostic and care pathways can the healthcare professional be reasonably certain that informed consent has been obtained and that a patient's moral, ethical and spiritual beliefs, expectations, and any misconceptions about their condition, have been taken into account. Consideration should be given to any communication problems the person may have.

Update information

This guideline is an update of NICE guideline CG95 (published March 2010) and will replace it.

New recommendations have been added for the diagnosis of chest pain of recent onset.

These are marked as:

- **[new 2016]** if the evidence has been reviewed and the recommendation has been added or updated
- **[2016]** if the evidence has been reviewed but no change has been made to the recommended action.

NICE proposes to delete some recommendation from the 2010 guideline, because either the evidence has been reviewed and the recommendations have been updated, or NICE has updated other relevant guidance and has replaced the original recommendations. Recommendations that have been deleted or changed sets out these recommendations and includes details of replacement recommendations. Where there is no replacement recommendation, an explanation for the proposed deletion is given.

Where recommendations are shaded in grey and end **[2010]**, the evidence has not been reviewed since the original guideline. Yellow shading in these recommendations indicates wording changes that have been made for the purposes of clarification only.

Where recommendations are shaded in grey and end **[2010, amended 2016]**, the evidence has not been reviewed but changes have been made to the recommendation wording that change the meaning (for example, because of equalities duties or a change in the availability of medicines, or incorporated guidance has been updated). These changes are marked with yellow shading, and explanations of the reasons for the changes are given in 'Recommendations that have been deleted or changed' for information.

See also the original NICE guideline and supporting documents.

Recommendations that have been deleted or changed

Recommendations to be deleted

Recommendation in 2010 guideline	Comment
Take a blood sample for troponin I or T measurement on initial assessment in hospital. These are the preferred biochemical markers to diagnose acute MI.(1.2.5.1)	Replaced by: For people at high or moderate risk of MI (as indicated by a validated tool), perform high-sensitivity troponin tests as recommended in the NICE diagnostics guidance on myocardial infarction (DG15).. (1.2.5.2)
Take a second blood sample for troponin I or T measurement 10–12 hours after the onset of symptoms.(1.2.5.2)	Replaced by: For people at high or moderate risk of MI (as indicated by a validated tool), perform high-sensitivity troponin tests as recommended in the NICE diagnostics guidance on myocardial infarction (DG15).. (1.2.5.2) For people at low risk of MI (as indicated by a validated tool): • perform a second high-sensitivity troponin test as recommended in the NICE diagnostics guidance on myocardial infarction (DG15) if the first troponin test at presentation is positive • consider performing a single high-sensitivity troponin test only at presentation to rule out NSTEMI if the first troponin test is below the lower limit of detection (negative). (1.2.5.3)
Novel cardiac biomarkers in people with acute chest pain (research recommendation 4.2)	Research question has been addressed by this 2016 update of CG95

1 Amended recommendation wording (change to meaning)

Recommendation in 2010 guideline	Recommendation in current guideline	Reason for change
Take a resting 12-lead ECG and a blood sample for troponin I or T measurement (see section 1.2.5) on arrival in hospital. (1.2.4.1)	Take a resting 12-lead ECG and a blood sample for high-sensitivity troponin I or T measurement (see section 1.2.5) on arrival in hospital. (1.2.4.1)	Updated to clarify the use of high sensitivity troponin testing.
Take into account the clinical presentation, the time from onset of symptoms and the resting 12-lead ECG findings when interpreting high sensitivity troponin measurements. (1.2.5.5)	When interpreting high-sensitivity troponin measurements, take into account: • the clinical presentation • the time from onset of symptoms • the resting 12-lead ECG findings • the pre-test probability of NSTEMI • the length of time since the suspected ACS • the probability of chronically elevated troponin levels is some people • that 99th percentile thresholds for troponin I and T may differ between the sexes. (1.2.5.6)	Updated to clarify the use of high sensitivity troponin testing.
When diagnosing MI, use the universal definition of myocardial infarction [2]. This is the detection of rise and/or fall of cardiac biomarkers (preferably troponin) with at least one value above the 99th percentile of the upper reference limit, together with evidence of myocardial ischaemia with at least one of the following: • Symptoms of ischaemia • New or presumed new significant ST-segment-T wave(ST-T) changes or new left bundle branch block (LBBB)	When diagnosing MI, use the universal definition of myocardial infarction. This is the detection of rise and/or fall of cardiac biomarkers values [preferably cardiac troponin (cTn)] with at least one value above the 99th percentile of the upper reference limit with at least one of the following: • symptoms of ischaemia • new or presumed new significant ST-segment-T wave(ST-T) changes or new left bundle branch block (LBBB) • development of	Updated reference to universal definition of MI and removal of the reference to autopsy as a diagnostic criteria in this context.

• Development of pathological Q waves in the ECG • Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality . • Identification of an intracoronary thrombus by angiography or autopsy (1.2.6.1)	pathological Q waves in the ECG • imaging evidence of new loss of viable myocardium or new regional wall motion abnormality • identification of an intracoronary thrombus by angiography (1.2.6.1)	
Reassess people with chest pain without raised troponin levels (determined from appropriately timed samples) and no acute resting 12-lead ECG changes to determine whether their chest pain is likely to be cardiac. If myocardial ischaemia is suspected, follow the recommendations on stable chest pain in this guideline (see section 1.3). Use clinical judgement to decide on the timing of any further diagnostic investigations. (1.2.6.5)	Reassess people with chest pain without raised troponin levels and no acute resting 12-lead ECG changes to determine whether their chest pain is likely to be cardiac. If myocardial ischaemia is suspected, follow the recommendations on stable chest pain in this guideline (see section 1.3). Use clinical judgement to decide on the timing of any further diagnostic investigations. (1.2.6.5)	. To align with new recommendation 1.2.5.3 which suggests that a single test may be used for rule out.

1

2 ISBN