Cerner's mission is to contribute to the systemic improvement of health care delivery and the health of communities.

We are transforming health care by eliminating error, variance and waste for health care providers and consumers around the world. Our software solutions optimize processes for health care organizations ranging from single-doctor practices to entire countries, for the pharmaceutical and medical device industries, and for the field of health care as a whole. Our solutions are licensed by more than 9,000 facilities worldwide.
Working in Partnership

- **Cerner**
  - Provide Electronic Patient Records across the UK and Globally

- **BMJ**
  - Use the Electronic Patient Record to deliver decision support based on best evidence
  - Information is delivered at the point of care
Evidence into Practice

- It took 200 years before the Royal Navy routinely used lemon juice to prevent scurvy. First study 1601

- Routine use of thrombolytic therapy in acute MI early 1990s. The first RCT that showed the benefit late 1950s

- Antenatal corticosteroid use in preterm labour - 22 years for international guidelines to first recommended after first evidence

- On average it takes 17 years for 14% of clinical research to become routine practice


The burden of evidence is significant

...although figures vary

- 35,000 biomedical journal articles published annually
- 150,000 articles / month
- 120,000 RCT/year
- 500,000 articles are indexed in PubMed every year
Patient Safety

- Adverse event rate in UK hospitals as high as 10.8% \(^1\)
- 190,000 deaths from adverse events in US annually \(^2\)
- Cost to the health system £650m annually
- Caused by slips, lapses, mistakes and non-uniform or poorly evidenced care
- Results in increased mortality, morbidity and a higher cost of care

Manage Future Demand – EVIDENCE

We know there is a great deal of variation...

Despite 15 years of evidence based standardisation there is still wide variation in outcomes across the NHS

4 fold variance of your chances of surviving a stroke across London

6 fold variance of your chances of surviving an aneurism across London

10 fold variance of your chances of surviving a heart attack across London
Action SETS
CARE PROTOCOLS
FROM THE BMJ EVIDENCE CENTRE

- Lists of actions, tests or treatments required to diagnose and manage patients
- 523 sets covering over 150 conditions
- Evidence based
- Internationally peer reviewed
- Designed for CPOE / Order Comms systems but can also be used for paper processes
Phased to cover the whole care pathway divided into appropriate care settings

Include International guidelines and drug database links

Deep links to the evidence and learning resources

Can be customised to meet local practice, formulary and guidelines

Updated automatically as the evidence changes
<table>
<thead>
<tr>
<th>Trolley</th>
<th>Name</th>
<th>Age</th>
<th>Reason for Visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>01,A</td>
<td>Hamilton, Robert</td>
<td>57</td>
<td>Chest Pain - Cardiac</td>
</tr>
<tr>
<td>01,AH</td>
<td>Taylor, Helen</td>
<td>51</td>
<td>Abdo Pain</td>
</tr>
<tr>
<td>02,A</td>
<td>Edwards, George</td>
<td>64</td>
<td>Laceration</td>
</tr>
<tr>
<td>04,A</td>
<td>Jones, Paul</td>
<td>72</td>
<td>? Stroke</td>
</tr>
<tr>
<td>06,AH</td>
<td>Bell, Ian</td>
<td>44</td>
<td>Abdo Pain</td>
</tr>
<tr>
<td>Trauma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trauma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WR AE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
We are now in the orders section of Mr Hamilton’s electronic health record.

The Problem of Acute Chest Pain is recorded in the patient record.
A list of Action Sets is displayed relevant to Acute Chest Pain.
The Action Set is ordered, showing all the possible phases
Nursing requests

Medication and i.v. fluid requests

Including dose instructions
Pathology tests
Radiology and other tests
Specialist Referrals
New phase selected as patient progresses
New set of evidence based orders

<table>
<thead>
<tr>
<th>Medications</th>
<th>Dosage</th>
<th>Route</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>diltiazem</td>
<td>120 unit/kg, Subcutaneous, SQn</td>
<td>Every twelve hours</td>
<td></td>
</tr>
<tr>
<td>heparin</td>
<td>60 unit/kg, IV Injection</td>
<td>Once only, loading dose maximum of 7,000 units/kg</td>
<td></td>
</tr>
<tr>
<td>heparin 25,000 units/D5W 500mL</td>
<td>500 mL, IV, T, N, 40 hour, 1,000 U/h maximum</td>
<td>70 s, continue for 48 hours</td>
<td></td>
</tr>
<tr>
<td>enoxaparin</td>
<td>120 unit/kg, Subcutaneous, SQn</td>
<td>Every twelve hours</td>
<td></td>
</tr>
<tr>
<td>enoxaparin</td>
<td>30 mg, IV Injection</td>
<td>Once only, bolus</td>
<td></td>
</tr>
<tr>
<td>enoxaparin</td>
<td>0.75 mg/kg, Subcutaneous, Injection</td>
<td>Twice a day, no loading dose</td>
<td></td>
</tr>
<tr>
<td>enoxaparin</td>
<td>1 mg/kg, Subcutaneous, Injection</td>
<td>Once a day</td>
<td></td>
</tr>
<tr>
<td>bivalirudin</td>
<td>0.1 mg/kg, IV Injection</td>
<td>Once only, bolus, on admission</td>
<td></td>
</tr>
<tr>
<td>enoxaparin</td>
<td>1 mg/kg, Subcutaneous, Injection</td>
<td>Every twelve hours</td>
<td></td>
</tr>
</tbody>
</table>
ENOXAPARIN SODIUM

Additional information interactions ("Enoxaparin").

Indications see notes above and under preparations

Cautions see under Heparin and notes above; low body-weight (increased risk of bleeding)

Contra-indications see under Heparin

Hepatic impairment manufacturer advises caution—no information available

Renal impairment risk of bleeding increased; reduce dose if eGFR less than 30 mL/minute/1.73 m²—consult product literature for details; monitoring of anti-factor Xa may be required; use of unfractionated heparin may be preferable
## Diagnostic tests

### ECG for likely acute coronary syndrome

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECG</td>
<td>ST-elevation MI (STEMI); ST-segment elevation &gt;1 mm in &gt;2 anatomically contiguous leads or new left bundle-branch block; non-ST-elevation MI (NSTEMI) or unstable angina: non-specific; ST-segment depression or T-wave inversion</td>
<td>ECG should be obtained in all patients with chest pain within 10 minutes of presentation. Serial ECGs are extremely important, as many cases of ACS present with normal initial ECGs.</td>
</tr>
</tbody>
</table>

**Information from:**

*Best Practice: Assessment of chest pain*

### ECG for likely stable angina

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECG</td>
<td>no acute changes; may have evidence of previous infarction, such as Q waves</td>
<td></td>
</tr>
</tbody>
</table>

**Information from:**

*Best Practice: Assessment of chest pain*
Assessment of chest pain

Summary

Chest pain is a common chief complaint, accounting for 5% to 8% of all emergency department visits in the US per year,[1] and is the presenting complaint in 1% to 2% of office-based visits.[2] In general practice in the UK, the incidence of newly diagnosed chest pain is 15.5 per 1000 person-years.[3]

Chest pain may be caused by either benign or life-threatening aetiologies and is usually divided into cardiac and non-cardiac causes. Acute coronary syndrome (ACS) encompasses unstable angina and MI. ACS affects only a few of the patients presenting with chest pain, but excluding ACS is vital because of the mortality associated with untreated MI. This monograph concentrates on the assessment of chest pain in the emergency setting.

Differential diagnosis

Sort by: common/uncommon or category

Common
- Acute coronary syndrome
- Stable angina
- Pulmonary embolism
- Pneumonia
- Viral pleuritis
- GORD
- Costochondritis
- Anxiety or panic disorder

Uncommon
- Pericarditis
- Cardiac tamponade
- Aortic dissection
- Aortic stenosis
- Mitral valve prolapse
- Pneumothorax
- Pulmonary hypertension
- Peptic ulcer disease (PUD)
Assessment of chest pain

Overview
- Summary
- Aetiology

Emergencies
- Urgent considerations

Diagnosis
- Step-by-step
- Differential diagnosis
- Guidelines

Resources
- References
- Images
- Patient leaflets
- Credits

Urgent considerations

See Differential Diagnosis for more details

Acute chest pain warrants rapid clinical assessment, as underlying disease can be life-threatening. Continuous monitoring of pulse, BP, and oxygen saturation is standard care. If the patient is in pain or breathless, or oxygen saturation is <90%, high-flow oxygen should be given. Morphine (IV) may also be necessary to relieve severe pain.

Initial investigations include a 12-lead ECG, CXR, cardiac biomarkers, FBC, and renal profile. The patient may need to be transferred to an intensive care setting. Once the patient is stable, further tests such as a VO_2 scan, echocardiography, CT, or angiography should be requested to confirm clinical suspicion.

Acute coronary syndrome

Acute coronary syndrome (ACS) refers to acute myocardial ischaemia caused by atherosclerotic coronary disease and includes ST-elevation MI (STEMI), non-ST-elevation MI (NSTEMI), and unstable angina (UA). These terms are used as a framework for guiding management.

Patients with STEMI need to be urgently triaged, as they may have life-threatening arrhythmias, cardiogenic shock, or pulmonary oedema. STEMI presents with a severe control chest pressure radiating to the jaw or upper extremities. There can be associated nausae and vomiting. Anticoagulation and acute reperfusion therapy with angioplasty if available within 2
Assessment of chest pain

Differential diagnosis
Sort by: common/uncommon or category

Common
- Acute coronary syndrome
- Stable angina
- Pulmonary embolism
- Pneumonia
- Viral pleuritis
- GORD
- Costochondritis
- Anxiety or panic disorder

Uncommon
Assessment of chest pain

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- Credits

Differential diagnosis
Sort by: common/uncommon or category

Common show all
- Acute coronary syndrome
- Stable angina
- Pulmonary embolism

History
- Sharp and pleuritic in nature
- Shortness of breath
- Haemorrhage may occur if pulmonary infarction develops
- Massive PE results in syncope
- Risk factors: history of immobility, orthopaedic procedures, oral contraceptive use, previous PE, hypercoagulable states, or recent travel over long distances
- Unilateral swollen lower leg that is red and painful
- DVT: use of the modified Wells criteria can help to screen for

Exam
- Tachycardia, loud P2, right-sided S4 gallop, jugular venous distension, fever, right ventricular lift
- Massive PE may cause hypotension

1st test
- ECG: atrial fibrillation, presence of S1, Q3, and T3
- D-dimer: non-specific if positive
- PE excluded if result negative in patients with low probability of having a PE
- CXR: decreased perfusion in a segment of pulmonary vasculature (Westmark sign)
- Presence of pleural effusion

Other tests
- Echocardiography: acute right ventricular dilatation and hyperkinesis
- V/Q scan: V/Q mismatch
- Pulmonary angiography: identification of thrombus in the pulmonary circulation

See our comprehensive coverage of Pulmonary embolism

Add notes | Bookmark | Add to Portfolio | Share | Feedback | Print | Email
Pulmonary embolism

History & exam
Key factors
- presence of risk factors
- chest pain
- dyspnoea
- syncope
- tachypnoea
- hypotension (systolic BP <90 mmHg)

Other diagnostic factors
- feeling of apprehension
- cough
- haemoptysis
- tachycardia
- fever
- elevated jugular venous pressure
- oedema

Diagnostic tests
1st tests to order
- ECG
- CXR
- ABG
- modified Wells score
- Geneva score
- D-dimer
- multi-detector computed tomography (MDCT) of chest
- ventilation-perfusion scan (VQ scan)

Tests to consider
- transthoracic echocardiography (TTE)
- INR and activated partial thromboplastin time
- Prosthetic valve echocardiography (PVE)

Presumptive
depends on risk factors

BP <90 mmHg
- oxygen + mechanical ventilation
- judicious IV fluids
- anticoagulation
- vasopressor/vasodilator therapy

BP >90 mmHg
- oxygen
- anticoagulation

Acute
corrected PE: BP <90 mmHg
- no excessive risk of bleeding
Assessment of chest pain

Overview
Summary
Aetiology

Emergencies
Urgent considerations

Diagnosis
Step-by-step
Differential diagnosis
Guidelines

Resources
References
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Differential diagnosis
Sort by: common/uncommon or category

Common show all

- Acute coronary syndrome
- Stable angina

Pulmonary embolism

See our comprehensive coverage of Pulmonary embolism

History
sharp and pleuritic in nature; shortness of breath; haemoptysis may occur if pulmonary infarction develops; massive PE results in syncope; risk factors: history of micturition, orthopaedic procedures, oral contraceptive use, previous PE, hypercoagulable states, or recent travel over long distances; [26] unilateral swollen lower leg that is red and painful suggests DVT; use of the modified Wells criteria can help to screen for

Exam
tachycardia, loud P2, right-sided S4 gallop, jugular venous distention, fever, right ventricular lift, massive PE may cause hypotension [26]

1st test
- ECG: sinus tachycardia, presence of ST, Q3, and TR
- D-dimer: non-specific if positive; PE excluded if result negative in patients with low probability of having a PE
- CXR: decreased perfusion in a segment of pulmonary vasculature (Westmark sign); presence of pleural effusion
- CT pulmonary angiography: identification of thrombus in the pulmonary circulation

Other tests
- echocardiography: acute right ventricular dilatation or hypokinesis
- VIQ scan: VIQ mismatch
- pulmonary angiography: identification of thrombus in the pulmonary circulation

28
Assessment of chest pain

Overview
- Summary
- Aetiology

Emergencies
- Urgent considerations

Diagnosis
- Step-by-step
- Differential diagnosis

Resources
- References
- Images
- Patient leaflets
- Credits

Differential diagnosis
Sort by: common/uncommon or category

Common
- Acute coronary syndrome

History
- Central chest pressure, squeezing or heaviness; radiation to jaw or upper extremities; associated nausea, vomiting, dyspnoea, dizziness, weakness; occurs at rest or accelerating tempos (crescendo); risk factors: smoking, age (men >45, women >55 years), positive FHx of premature CAD, hypertension, hyperlipidaemia, diabetes, stroke, or peripheral arterial disease [6] [7]

Exam
- Examination may be normal; jugular venous distension, S4 gallop, holosystolic murmur (mitral regurgitation), basilar rales; hypotensive, tachycardic, bradycardic, or hypoxic depending on severity of ischaemia [8] [7]

1st test
- ECG: ST-elevation MI (STEMI): ST-segment elevation >1 mm in ≥2 anatomically contiguous leads or new left bundle-branch block; non-ST-elevation MI (NSTEMI) or unstable angina: non-specific; ST-segment depression or T-wave inversion
- CXR: normal or signs of heart failure, such as increased alveolar markings
- Cardiac enzymes: elevated in STEMI and NSTEMI, not elevated in unstable angina

Other tests
- BNP: >90th percentile of normal
- Coronary angiography: STEMI: critical occlusion of a coronary artery, NSTEMI and unstable angina: evidence of coronary artery narrowing

See our comprehensive coverage of Overview of acute coronary syndrome
Assessment of chest pain

Step-by-step diagnostic approach

Chest pain can be triaged into traumatic and atraumatic aetiologies. The evaluation of atraumatic chest pain requires an algorithmic approach that first excludes acute myocardial ischaemia before working through the various aetiologies of chest pain.

History

The character of chest pain should be determined, as this can help differentiate between cardiac, respiratory, musculoskeletal, and other causes. The type, severity, location, and duration of pain; the presence of any radiation; and exacerbating or relieving factors may be helpful in pointing towards a diagnosis. Clinical presentation alone cannot reliably determine acute coronary syndrome (ACS). [10] [11] Past medical history and specific cardiac risk factors such as known cardiac disease, raised cholesterol, hypertension, smoking, and family history support a cardiac cause. [12] Cocaine use also makes cardiac ischaemia more likely. [13] A detailed drug history should also be taken (e.g., use of NSAIDs may result in gastric aetiology).

Certain characteristics of chest pain can give clues to the origin.

- Constricting pain may be due to cardiac ischaemia or oesophageal spasm.
- Pain that lasts >20 minutes and is dull, central, and crushing is likely to be caused by an MI.
- Pain that radiates to the jaw or upper extremities suggests a cardiac cause.
I need to learn more about this subject

Step-by-step diagnosis
Chest pain can be triggered by traumatic chest pain requiring ischaemia before working...

History
The character of chest pain may be cardiac, respiratory, musculoskeletal, or duration of pain: the presence is helpful in pointing towards acute coronary syndrome such as known cardiac disease or support a cardiac cause. A detailed drug history should be taken (e.g., use of nitrates, may result in angina).

Certain characteristics of chest pain can give clues to the origin.

- Constricting pain may be due to cardiac ischaemia or oesophageal spasm.
- Pain that lasts >20 minutes and is dull, central, and crushing is likely to be caused by an MI.
- Pain that radiates to the jaw or upper extremities suggests a cardiac cause.
Step-by-step diagnosis

Chest pain can be triggered by trauma caused by ischemia before working.

History

The character of chest pain can be caused by respiratory, muscular, or cardiac, duration of pain; the presence of chest pain helps in pointing towards acute coronary syndrome. Acute coronary syndromes include conditions such as known cardiac disease, mitral regurgitation, or support a cardiac cause. A detailed drug history should be taken (e.g., use of Nitrates may relate to angina).

Certain characteristics of chest pain can give clues to the origin:

- Constricting pain may be due to cardiac ischemia or oesophageal spasm.
- Pain that lasts >20 minutes and is dull, central, and crushing is likely to be caused by an MI.
- Pain that radiates to the jaw or upper extremities suggests a cardiac cause.
**Step-by-step diagnosis of chest pain**

Chest pain can be triggered by atypical causes, such as ischaemia. Before working up this diagnosis, it is helpful to know the character of the pain:

**History**

The character of chest pain can guide the doctor to the most probable cause:

- Cardiac:
  - Constricting pain
  - Pain that lasts >20 minutes
  - Pain that radiates to the jaw or upper extremities
- Respiratory:
  - Sharp chest pain
- Musculoskeletal:
  - Squeezing chest pain
- Gastroesophageal:
  - Sharp pain
- Other:
  - Numbness or weakness

**Add to portfolio**

- **Title:** Assessment of chest pain
- **Notes:** I need to learn more about this subject
- **Tags:**
  - **TAG SETS**
    - select a tag
  - **MY TAGS**
    - Learning Need
      - Choose from your personal tags

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Step-by-step diagnosis

Chest pain can be triggered by both traumatic and non-traumatic causes. It is important to differentiate between non-traumatic causes of chest pain, which might be caused by anxiety or angina, and traumatic causes, which could be caused by a broken rib.

History

The character of chest pain can often give clues about its origin. For example, if the pain is sharp, it is more likely to be caused by a broken rib. If the pain is a dull, central, and crushing sensation, it is more likely to be caused by angina.

Certain characteristics of chest pain can give clues to the origin.

- Constricting pain may be due to cardiac ischaemia or oesophageal spasm.
- Pain that lasts >20 minutes and is dull, central, and crushing is likely to be caused by an MI.
- Pain that radiates to the jaw or upper extremities suggests a cardiac cause.

Add to portfolio

Title: Assessment of chest pain
Notes: I need to learn more about this subject
Tags: Learning Need
Step-by-step diagnosis

Chest pain can be triggered by a non-traumatic chest pain requiring a detailed drug history. Before working on the diagnosis of chest pain, the patient’s detailed drug history should be taken.

Certain characteristics of chest pain can give clues to the origin.

- Constricting pain may be due to cardiac ischaemia or oesophageal spasm.
- Pain that lasts >20 minutes and is dull, central, and crushing is likely to be caused by an MI.
- Pain that radiates to the jaw or upper extremities suggests a cardiac cause.
Step-by-step diagnostic approach

Chest pain can be triaged into traumatic and atraumatic aetiologies. The evaluation of atraumatic chest pain requires an algorithmic approach that first excludes acute myocardial ischaemia before working through the various aetiologies of chest pain.

History

The character of chest pain should be determined, as this can help differentiate between cardiac, respiratory, musculoskeletal, and other causes. The type, severity, location, and duration of pain; the presence of any radiation; and exacerbating or relieving factors may be helpful in pointing towards a diagnosis. Clinical presentation alone cannot reliably determine acute coronary syndrome (ACS). [10] [11] Past medical history and specific cardiac risk factors such as known cardiac disease, raised cholesterol, hypertension, smoking, and family history support a cardiac cause. [12] Cocaine use also makes cardiac ischaemia more likely. [13] A detailed drug history should also be taken (e.g., use of NSAIDs may result in gastric aetiology).

Certain characteristics of chest pain can give clues to the origin.

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- Pain that lasts >20 minutes and is dull, central, and crushing is likely to be caused by an MI.
- Pain that radiates to the jaw or upper extremities suggests a cardiac cause.
Search Results for search term “chest pain”

1. Acute chest pain: diagnosis and management: in association with Heart
2. The ECG in patients with chest pain: diagnostic picture tests
3. Chest pain: a guide to investigation and management for GPs
4. Chest pain of recent origin - assessment and diagnosis: in association with NICE
5. Chest radiographs: a guide to interpretation
6. Non-invasive cardiac imaging in the patient with chest pain: coronary CT angiography
7. Managing recurrent chest infections in a child
8. The ECG in patients with chest pain: diagnosis and management
9. Chest x ray: an essential guide to interpretation
10. Chest x rays: a guide to interpretation - part 2
11. Chest x rays: a guide to interpretation - part 1
13. Acute thoracic aortic syndromes: in association with Heart
Acute chest pain: diagnosis and management: in association with Heart

Learning outcomes

When you have completed this module you should understand:

- How to assess risk in patients with an acute coronary syndrome
- The natural history of acute coronary syndrome
- The potential pitfalls in interpreting data in affected patients
- How to choose who needs early intervention
- The best combinations of drug treatments and interventions.

Author

Christopher SR Baker

Biography

Christopher SR Baker, Charing Cross and Hammersmith Hospitals, London,
RFH Pilot

• Royal Free Hospital pilot of BMJ Action Sets targeting the management of upper GI bleeding

• Examined two quality indicators in the initial management
  ▪ Rockall Scores and use of i.v. proton pump inhibitors

• Rockall scoring is a simple risk assessment tool which takes account of age, signs of shock and co-morbidity
  
• Patients with a score of 0 or 1 have <1% mortality


RFH Pilot - data

- 0% of acute clinicians calculated a Rockall score on admission
- 0% of gastroenterology clinicians calculated a Rockall score on admission
- 50% of inpatient endoscopy patients had a Rockall score of 0 (length of stay 3-5 days)
- 65% of patients received i.v. pantoprazole pre-endoscopy

1. Unpublished data from the Royal Free Hospital, presented at the Cerner Health Conference by Dr. O’Bierne, September 2010
• RFH implemented the BMJ upper GI bleed Action Set in Cerner Millennium system

• Adapted it to their organisation

• Recent data presented at the BSG:
  - Rockall score recorded – 33%
  - Discharge from A&E if Rockall score 0 – 100%
  - Inappropriate PPI use – 67% reduction
We are in ‘IT’ together