Provincial Clinical Knowledge Topic
Chest Pain, Suspected Cardiac - Adult Emergency Department

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Revision History

Version	Date of Revision	Description of Revision	Revised By
1.0	September 2015	Version 1 complete	
1.1	March 2017	HEART Score link updated (page 5 and 39), link to Asses Reasses guideline added (page 7), link to Suspected Ischemic Chest Pain protocol, ESCN - HCS-195-01 added (page 10), Oxygen requirements updated (page 7 and PICO #6)	Dr McRae / Dr Bullard / Dr Hall

Important Information Before You Begin

The recommendations contained in this knowledge topic have been provincially adjudicated and are based on best practice and available evidence. Clinicians applying these guidelines should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care. This knowledge topic will be reviewed periodically and updated as best practice evidence and practice change.

The information in this topic strives to adhere to Institute for Safe Medication Practices (ISMP) safety standards and align with Quality and Safety initiatives and accreditation requirements. Some examples of these initiatives or groups are: Health Quality Council Alberta (HQCA), Choosing Wisely campaign, Safer Healthcare Now campaign etc.

Within this knowledge topic PICO-D questions or key clinical questions that have been used to guide research using the **P**opulation/**P**roblem, **I**ntervention, **C**omparison, **O**utcome, **D**esign format. These questions are listed in Appendix A.

Links to PICO questions or Appendices are throughout the document (example: **(PICO 1) or Appendix A**). Click on the link with your mouse to follow the link. Under the PICO-D question or Appendix heading you will find a link to return you to your place in the document.

Rationale

Chest pain and suspected acute coronary syndromes (ACS) are common emergency department (ED) presenting complaints, accounting for over 40,000 ED visits annually across Alberta.[1]

One important objective of chest pain assessments is to either rule-in or rule-out ACS. These include ST-segment elevation myocardial infarction (STEMI), non-ST-segment myocardial infarction (NSTEMI) and unstable angina (UA). These diagnoses are associated with high risk for adverse outcomes, including a 30-day mortality of 2-10%, therefore ED workups for potential ACS must be highly sensitive. Evaluations for potential ACS must also be highly specific, as only 15% of patients with symptoms suggestive of ACS will actually have an ACS. It is important to be able to quickly and accurately identify the large proportion of potential ACS patients who have a non-cardiac, and non-life threatening cause for their ED presentation, in order to prevent unnecessary admissions, invasive diagnostic testing and ED crowding.

This document is intended to summarize the most recent evidence guiding the optimal evaluation and initial management of ED patients with suspected ACS and to assist in the development of clinical content that supports clinicians to efficiently implement these recommendations.

The differential diagnosis for patients with symptoms of a potential ACS is broad, including aortic dissection, pulmonary embolism, pericarditis, anxiety, chest wall pain, pulmonary and upper gastrointestinal diseases. For further evidence in working up the differential diagnosis of chest pain, we refer the reader to those topic-specific documents.

Goals of Management

1. ABC: Protect airway and support oxygenation as appropriate, including administration of supplemental oxygen. Administration of fluids and vasoactive medications as appropriate
2. Rapid ECG assessment (target is 10 minutes from arrival in ED)[2]
3. Administration of acetylsalicylic acid (ASA) for patients with suspected acute coronary syndrome (ACS) (given by self, pre hospital, or in the ED)[2]
4. Treatment of STEMI with fibrinolytic therapy within 30 minutes of ED arrival or percutaneous coronary intervention (PCI) within 90 minutes of ED arrival[2,3]
5. Perform patient directed history taking, identifying cardiac or other risks, to ensure an appropriate investigation and management strategy are initiated[4]
6. Stratify risk using validated risk scores to determine the extent of ED and post ED investigations required[5-7]
7. Appropriately-timed troponin assays for patients with suspected cardiac chest pain
8. Administration of sublingual, transcutaneous or intravenous nitroglycerin or opioids as required for symptom relief
9. Timely consultation and admission for high-risk patients or biomarker/ electrocardiogram-proven ACS, and initiation of evidence-based ACS therapies[3,4,8]
10. Arrangement of appropriate outpatient investigations and follow-up for patients with high-risk clinical characteristics but no objective evidence of Acute Myocardial Infarction (AMI)

Nursing Assessment and Documentation

This section contains specific considerations related to this topic. Standard assessment and documentation practices should still be followed.

1. Triage Assessment
    - Vital signs, including a glucose (as indicated)
    - Canadian Emergency Department Information Systems (CEDIS) complaints[9]:
        - Chest pain, cardiac features
        - Chest pain, non-cardiac features
        - Shortness of breath
    - Canadian Triage and Acuity Scale (CTAS) Modifiers[9]:
        - For Chest pain, cardiac features
            - Unless hemodynamic compromise or severe shortness of breath the patient will automatically be scored a CTAS level 2
            - EDs need to develop a process or protocol to record an ECG (target within 10 minutes) and to also ensure that a physician reviews it where possible and determines, based on communication with the nurse, whether he/she needs to see the patient to make any decision, whether to move the patient into an ED treatment space, or whether the patient can safely wait (and if so are there any orders for the nurse to carry out during that waiting period)
        - For the other 2 complaints
            - Acute central pain severity, respiratory distress, or hemodynamic status are the modifiers most likely to determine the triage score assigned.
            - "Ripping, tearing pain" is a CTAS level 2 modifier for Chest pain, non-cardiac features
2. Initial Assessment/Documentation
    - Presenting History: Character of pain, pain score, time of onset, duration, location, radiation, aggravating factors, alleviating factors
    - Past History: Ischemic or other heart disease, sympathomimetic use (cocaine, amphetamines)
    - Medications & Allergies: All meds but focused on acetylsalicylic acid (ASA) and other antiplatelet agents, anticholesterol agents, calcium channel blockers, angiotensin converting enzyme (ACE) inhibitors, angiotensin II receptor blockers (ARBs), phosphodiesterase inhibitors
    - Systems Review:
        - Vital Signs: Vital signs including blood pressure in both arms, SpO_2 and blood glucose
        - Cardiovascular: diaphoresis, chest tenderness, syncope/presyncope
        - Respiratory: dyspnea, tachypnea, cough
        - Neurological: mental status
        - Gastrointestinal: nausea, vomiting
        - Other: fever
    - Physical examination:
        - Cardiovascular: Central and peripheral pulses (regular/irregular, strength), diaphoresis, skin color, edema, chest tenderness
        - Respiratory: Adventitious lung sounds

Physician Assessment and Documentation

This section contains specific considerations related to this topic. Standard assessment and documentation practices should still be followed.

1. History of Present Illness
   - Character of pain, onset, duration, timing of recurrent episodes, location, radiation, aggravating factors, alleviating factors. Associated symptoms: dyspnea, tachypnea, presyncope/syncope, nausea/vomiting, diaphoresis
2. Past History
   - Ischemic or other heart disease, diabetes, hypertension, smoking, hypercholesterolemia, peripheral or cerebral vascular disease, venous thromboembolism (VTE), pulmonary disease, upper gastrointestinal disease
3. Medications & Allergies
   - All meds but focused on antiplatelet agents, anticholesterol agents, calcium channel blockers, ACE inhibitors, angiotensin II receptor blockers (ARBs), beta blockers, nitrates, antiarrhythmics, anticoagulants, phosphodiesterase inhibitors (sildenafil, tadalafil)
4. Review of Systems
   - Neurologic, cardiorespiratory or upper GI symptoms, leg swelling, fever
5. Family History
   - Ischemic heart disease, cerebrovascular accident (CVA), sudden unexplained death, VTE
6. Social History
   - Alcohol use, sympathomimetic use (cocaine, amphetamines)
7. Physical Examination
   - Focused examination looking for signs of congestive heart failure, valvular disease, chest wall tenderness, signs of poor peripheral or central perfusion, or other differential diagnostic considerations
8. Components of HEART Score: https://www.mdcalc.com/heart-score-major-cardiac-events (**PICO 1**) (**Appendix C**)

Initial Decision Making

1. Does this patient have active symptoms and ECG signs of ischemia?
    a. Yes and ST-segment elevation consistent with acute myocardial infarction:
        - Then initiate appropriate STEMI care, including fibrinolysis or transfer for percutaneous coronary intervention (PCI). Patients with signs of acute congestive heart failure or cardiogenic shock should be resuscitated per AHA/ACC ACLS guidelines and transferred for emergent PCI

    b. Yes with dynamic/pain-associated ST depression or T-wave inversion
        - Then initiate appropriate UA/NSTEMI therapy, including antiplatelet agents and anticoagulation and serial ECGs
2. Does this patient have active symptoms suspicious of acute coronary syndrome (ACS), but no ECG signs of ischemia?
    a. Yes
        - Based on cardiac risk scores consider the level of investigations warranted for this patient (**PICO 1**)
            - HEART Score (newer score developed and validated in ED chest pain patients. Sensitivity and specificity superior to other risk scores AND physician gestalt). (**Appendix C**)
        - Initiate appropriate symptom relief (nitroglycerin, analgesics) and perform symptom-appropriate monitoring and Troponin testing (**PICO 2**), (**PICO 3**), (**PICO 4**), (**PICO 5**), (**PICO 6**), (**PICO 7**)
3. Does this patient have chest pain or other symptoms that “could” be cardiac in origin, however, may also be non-cardiac?
    a. Yes, cardiac possible but alternate etiology also likely
        - Based on clinical gestalt and cardiac risk scores consider the level of investigations warranted for this patient
        - Consider other high risk diagnoses to determine whether or not they need to be ruled out
        - Initiate appropriate symptom relief and investigations

    b. No, non-cardiac seems more likely and cardiac very unlikely
        - Based on history, physical examination, and other risk factors develop the best appropriate differential diagnosis to begin investigating and decide in collaboration with your patient the need for ACS investigations and how you will manage a negative workup
4. Does this patient have chest pain that appears superficial, reproducible, and has a clear non cardiac explanation?
    a. Yes
        - Determine through careful history taking, examination, and discussion with the patient your respective comfort levels with your clinical impression and develop an investigation/discharge/follow up plan you are both comfortable with (**PICO 8**). Most patients with clearly non-cardiac pain may follow-up with primary care provider without additional outpatient testing.

Order Set Components

Orders or their components have been added in **bold** text if recommended as default (e.g. **Bedrest**). All other orders and components would be selected based on the presentation needs of the patient. Orders that have more than one option for treatment have been entered in square brackets (e.g. Warfarin 5 mg [2, 2.5, 3, 4, 6, 7.5, 10 mg] PO x 1).

General Care

- Goals of Care Designation: utilize appropriate Goal of Care
- Precautions and Safety:
    - Bedside Cardiac Monitoring: Patients with unstable hemodynamics or ongoing symptoms consistent with cardiac chest pain should have continuous cardiac and pulse oximetry monitoring. Patients with atypical chest pain may not need monitoring. Patients who are symptom-free do not require continuous cardiorespiratory monitoring. (**PICO 7**)
    - Oxygen Saturation Monitoring: Patients with unstable hemodynamics or ongoing symptoms consistent with cardiac chest pain should have continuous cardiac and pulse oximetry monitoring
- Activity:
    - **Bedrest**
    - Bedrest - With Bathroom Privileges
    - Activity as Tolerated
- Diet / Nutrition:
    - NPO
    - **NPO: oral medications with sips**
    - NPO: may have ice chips
    - Clear Fluids
    - Regular
    - Other: as required

Patient Care Orders

- Vital Signs: suggest starting with “as per local standards” as the default with specified options for patients whom physicians have a heightened level of concern about. These orders need to be re-evaluated when the patient stabilizes or by two hours, whichever occurs first. Vital signs to include: respiratory rate (RR), pulse rate (P), blood pressure (BP), temperature (T), and oxygen saturation (O_2 sat) with options to include:
    - **as per provincial guideline**
    - manual or automatic
    - every ___hourly
    - every ___minute(s)

Respiratory Care

Caution: Routine administration of oxygen may be harmful. Do not administer supplemental oxygen unless saturations are less than 90%.

- O2 Therapy - Titrate to maintain oxygen saturation at 90%.

Intravenous Orders

- Intravenous Cannula - Insert
- Saline Lock
- Bolus: IV "bolus" or "rapid infusion" including the following:
    - Amount (e.g., 250 mL, 500 mL, 1000 mL, 2000 mL)
    - Fluid (e.g., 0.9% NaCl infusion, lactated ringers infusion)
    - Run time (e.g., 15 min, 30 min, 45 min, 60 min)
- Maintenance: IV "maintenance"
    - Rate in mL/hr (e.g. 75, 100, 125, 150, 200, 250)
    - Fluid (e.g. 0.9% NaCl infusion, lactated ringers infusion)

Lab Investigations

Laboratory orders appear in **bold** text if recommended as usual default orders. Laboratory orders are underlined when needed to assess severity or establish a baseline. All other lab orders (e.g. investigations for possible comorbidities) are to be selected based on the presentation needs of the patient and are in regular font.

- Hematology
    - Complete Blood Count (CBC)
    - PT, INR
- Chemistry
    - Troponin**:** I or T
    - Repeat Troponin(s) X _____ times (collection time(s) to be specified)
    - Creatinine
    - Electrolytes (Na, K, Cl, CO_2)
    - Glucose
    - Urea
- Urine Tests
    - Pregnancy, Urine - POCT

**Comments regarding laboratory ordering and utilization for this patient group:

- In many patients, particularly those with low risk clinical histories, no laboratory testing is required. Therefore no default tests are indicated.
- The cornerstone of laboratory testing for acute MI is the serum troponin assay. Recommendations for timing of initial and serial troponin testing vary depending on which assay is performed in the local hospital laboratory (**PICO 5**)
- In patients not on warfarin, or who are not going to be receiving anticoagulant therapy in the ED, routine PTT/INR testing is not recommended.
- Routine D-Dimer (DVT/PE and DIC) testing should not be done. D-Dimer (DVT/PE and DIC) testing should be reserved for patients in whom the diagnosis of venous thromboembolism is being actively considered and who are at low risk according to Wells' criteria.

Diagnostic Investigations

- Standard X-rays - not routinely recommended unless concomitant/alternative diagnosis (e.g. CHF, pneumothorax) likely (**PICO 9**):
    - Chest X-ray 2 projections (posterior-anterior & lateral) or
    - Chest X-ray 1 projection, portable
- Other:
    - Electrocardiogram – 15 Lead: if signs of inferior ischemia or anterior ST depression
    - Electrocardiogram – 12 Lead: Serial electrocardiograms every _____ minutes repeat _____ times if ongoing symptoms suggestive of cardiac ischemia
    - Electrocardiogram – 12 Lead: PRN for recurrent episodes of chest pain

Medications

- ***Antiplatelet agents:*** (**PICO 10**)
    - acetylsalicylic acid 160 mg PO chewed once: should be administered to all patients at high risk of ACS as soon as practical after ED arrival if not taken by patient or administered by EMS prior to arrival. It is reasonable to delay ASA administration in low-risk patients or until an ACS diagnosis has been confirmed.

    If allergic to ASA or confirmed ACS:
    - ticagrelor 180 mg PO once: preferred agent for patients undergoing Percutaneous Coronary Intervention (PCI)

    OR
    - clopidogrel 300 mg [600 mg] PO once

- ***Nitrates:*** (**PICO 2**)
    - nitroglycerin SL: 0.4mg SL, every 5 minutes PRN, up to 5 sprays

    OR *If sublingual nitroglycerin ineffective and high probability of cardiac chest pain:*
    - nitroglycerin infusion: (non-weight based) start at 5 microgram/min IV continuous; increase by 5 to10 microgram/min every 3 to 5 minutes as needed up to 20 micrograms/min; then by 10 to 20 microgram/min every 3 to 5 minutes if needed to a maximum of 200 microgram/min

    OR
    - nitroglycerin infusion: (weight based) start at 0.1 to 0.2 microgram/kg/min IV continuous; increase by 0.1 microgram/kg/min every 3 to 5 minutes as needed up to 0.3 microgram/kg/min; then by 0.2 to 0.4 microgram/kg/min every 3 to 5 minutes if needed to a maximum of 200 microgram/min

    Refer to the AHS Provincial Parenteral Monograph for nitroglycerin infusion: Parenteral Monograph - Nitroglycerin
    Avoid in patients with systolic blood pressure less than 100, in MI with inferior/right-sided involvement or recent use of phosphodiesterase inhibitors (sildenafil/tadalafil within 24hours)

- ***Analgesics (if nitrates ineffective):***
  - morphine: 2.5 to 5 mg IV every 15 minutes PRN to maximum of 20mg

  OR
  - fentaNYL: 25 to 50 micrograms IV every 15 minutes PRN to maximum of 200 micrograms

- ***Anticoagulation:***
  - Anticoagulation is not indicated in patients with undifferentiated chest pain.
  - In patients with a diagnosis of unstable angina or NSTEMI, anticoagulant therapy (subcutaneous enoxaparin or fondaparinux, unfractionated heparin if renal insufficiency) should be initiated. In patients treated with fibrinolytic therapy for STEMI, an initial bolus dose of unfractionated heparin or enoxaparin should be given intravenously
  - Choice of anticoagulation should be made in conjunction with consulting/admitting physician as may be dictated by timing of coronary angiography. Fondaparinux should be avoided in patients undergoing an early invasive strategy.

Procedures, Policies & Guidelines

Nursing

- Initiate chest pain protocol:
  SUSPECTED ISCHEMIC CHEST PAIN Protocol

Disposition Planning

1. Patients with STEMI at a non-Percutaneous Coronary Intervention (PCI) site should arrange transfer to PCI center if PCI available within 120 minutes of patient presentation
2. Considerations for admission
    - High-risk findings on ECG or troponin testing
    - High-risk clinical history consistent with unstable angina, even with negative biomarkers
    - Moderate-risk clinical history, negative biomarkers, and inability to arrange urgent outpatient testing
3. Considerations for discharge
    - Patients with a HEART Score of 4-6 have a 13% 6-week risk of major adverse cardiac events. If discharged, they should receive urgent outpatient specialist (internal medicine or cardiology) follow-up and provocative testing. Patients with low-moderate risk of ACS but moderate risk of coronary artery disease should undergo outpatient provocative testing. (**PICO 11**), (**PICO 12**) (**Appendix C**). For HEART score calculator: https://www.mdcalc.com/heart-score-major-cardiac-events
    - Patients with a HEART score of 0-3 have a 6-week adverse cardiac event risk of less than 1.7% and do not require follow-up beyond their primary care physician. (**PICO 13**)(**Appendix C**).
    - Patients discharged to outpatient follow-up with clinical features of possible angina should be started on antiplatelet medication (ASA 80 mg daily) and given a prescription for SL nitroglycerin (**PICO 14**)
    - Patients should be given strict discharge instructions to return to the ED should they experience symptoms of possible ACS that do not respond to either rest or nitrates or that are increasing in frequency/easier to trigger
4. Patient education / discharge instructions
    - **Appendix D** (D1 [angina] and D2 [simple chest pain]) contains links to the Healthwise patient education being trialed by Health Link and being considered for access to Alberta EDs for our patients.

Rural Considerations

The major challenges and considerations from a rural perspective are:

1. Access to the newer highly sensitive troponins
2. Access to readily accessible provocative testing and timely Cardiology referral

Patient Experience and Expectations

Based on a meeting with 8 patient advisors in Calgary January 25, 2015, we received the following feedback and general recommendations regarding approaches to communication, care and patient expectations in the emergency department (ED):

1. They hoped we would be able to improve care consistency among ED providers.

    Patient quote: "Every time I presented to the emergency department with the same condition (atrial fibrillation), each doctor provided a different treatment approach."

2. They were supporters of care pathways, checklists, protocols, etc. wherever appropriate.

    Patient quote: "I am a strong supporter of care pathways as whenever I/my family member receive treatment using a pathway the care seems clearer and more consistent"

3. While none of the patients liked long waits, they could accept them better if there was clearer communication and reassessments as required.

    Patient quote: "Nobody likes to wait and I understand that sicker patients take priority, however, there needs to be improved communication and reassessments for those patients who are waiting"

4. They pointed out the importance of having a patient advocate accompany a sick person, but also allowing the advocate to be with the patient at decision critical points (e.g. initial assessment, treatment decision making, receiving bad news, etc.) was considered paramount.

    Patient quote: "When I accompany my family member to the ED I am often not permitted to join them when they are moved into a treatment space. I am often told this is 'policy'."

5. They believe that improving follow up, especially for patients being discharged from the ED and being referred to a specialist is important. This was recognized as a key safety risk for patients; having to rely on faxed referrals and a call back from the consultant's office can lead to dangerous delays or failed connections to the detriment of the patient's health and well-being.

    Patient quote: "The current health care system is poorly coordinated with lots of gaps and delays, especially with referrals from one physician to another."

Preparation for Analytics

1. Key Outcomes

   Clinical

   - Effective identification of high risk patients requiring admission
   - Successful identification of low/moderate risk requiring provocative testing
   - Safe identification of very low risk patients requiring no further investigations

   Process

   - Consistent nurse and physician adherence to the chest pain pathway
   - Chest pain clinic/protocol referrals consistently get patients seen and tested in accordance with the guidelines

   Patient Experience

   - Felt their pain and concerns were recognized and dealt with appropriately
   - The provocative testing was organized during the ED visit, easy to access, and completed as had been described.

2. Data Elements for Capture
   - Patient demographics
   - CEDIS presenting complaint and CTAS score
   - ED time markers (triage time to intial ECG, triage to physician, physician to consult and then to admission or physician to discharge) and outcome markers (identified as Clinical Decision Unit patient, consulted for admission, admitted to Intensive Care Unit or ward, died)
   - ED diagnoses for Chest pain ICD 10 R074 and ACS I209, I200
   - Site and zone identifiers
   - Date and time of Cardiology consultation
   - Date, time and dose of antiplatelets, anticoagulants and fibrinolytics (acetylsalicylic acid, clopidogrel, ticagrelor, unfractionated heparin, low molecular weight heparin, fondaparinux, tenecteplase)
   - Follow up plan (Family physician, Cardiologist, Coagulation clinic, none)
3. Proposed Reports
   - Number (%) of ED patients triaged as “chest pain-cardiac features”
   - Number (%) of ED chest pain patients consulted to cardiology
   - Number (%) of ED chest pain patients admitted

References

1. Data provided by AHS Data Integration, Management and Reporting (DIMR). February 2015.
2. Schull MJ, Hatcher CM, Guttmann A, et al. *Development of a Consensus on Evidence-Based Quality of Care Indicators for Canadian Emergency Departments. ICES Investigative Report*. Toronto: Institute for Clinical Evaluative Sciences; 2010.
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4. Panju AA, Hammelgarn BR, Guyatt GH, Simel DL. The rational clinical examination. Is this patient having a myocardial infarction? *JAMA*. 1998;280(14):1256-63.
5. Hess EP, Agarwal D, Chandra S, et al. Diagnostic accuracy of the TIMI risk score in patients with chest pain on the emergency department: a meta-analysis. *CMAJ* 2010;182(10):1039-1044.
6. Scheuermeyer FX, Wong H, Yu E, et al. Development and validation of a prediction rule for early discharge of low-risk emergency department patients with potential ischemic chest pain. *CJEM.* 2014;16(2):106-119.
7. Backus BE, Six AJ, Kelder JC, et al. A prospective validation of the HEART score for chest pain patients in the emergency department. *Int J Cardiol.* 2013;168(3): 2153-2158.
8. Amsterdam, DA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes. *Circulation*. 2014;130:e344-e426.
9. Murray M, Bullard M, Grafstein E; for the CTAS and CEDIS National Working Groups. Revisions to the Canadian Emergency Department Triage and Acuity Scale Implementation Guidelines. *CJEM*. 2004;6(6):421-427.

Appendix A – PICO-D Questions (Key Clinical Questions)

For information regarding PICO-D Methodology and GRADE Terminology please see **Appendix B**

PICO Question 1: ***In adult patients presenting to the ED with chest pain suspicious for ischemic cardiac disease but a normal ECG what is the value of various cardiac risk-scores in clinical decision-making?***

Return to Important Information Before You Begin
Return to Physician Assessment and Documentation
Return to Initial Decision Making

Population, Patient or Problem: Adults with chest pain suspicious for ischemic cardiac disease but a normal ECG
Intervention, Prognostic Factor, Exposure: TIMI or Modified TIMI, Vancouver or North American or HEART score
Comparison: Clinical judgment
Outcome: sensitivity, specificity in ruling in or ruling out acute coronary syndrome
Design: RCTs or Prospective Observational studies compared to reference standard

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials.

Clinical Recommendation: We recommend that emergency physicians use a structured risk score for the evaluation of patients with suspected ACS as structured scoring systems have superior discriminative properties than clinical gestalt.

Emergency physician gestalt, when combined with ECG and high-sensitivity troponin testing has similar sensitivity to the HEART score. However, the HEART score had better specificity, meaning that more low-risk patients can be identified and safely discharged using the HEART score than using clinical gestalt.

The New Vancouver Chest Pain Rule, HEART Score and North American Chest Pain Rule have similar sensitivities for ACS, although the HEART Score and Modified TIMI have superior specificity. A high-risk modified-TIMI or HEART score are reasonably predictive of short-term adverse cardiac event risk and may be useful to quantify short-term risk.

Observational cohort studies evaluating the sensitivity of various risk scores for ruling out ACS indicate that the best-performing risk scores (which include cardiac troponin measurement), namely a modified TIMI score, New Vancouver Rule and the HEART score, have a sensitivity of approximately 96% for 6-week major adverse cardiac events, meaning that low-risk patients according to these scores can be discharged from the ED with low short-term adverse event risk. Patients with high-risk modified TIMI scores or HEART scores had a 6-week positive predictive value for adverse cardiac events of 42-50%, with specificities of 73% and 88% respectively.

Quality of Evidence: Moderate, GRADE B.

Strength of Recommendation: GRADE 1, Strong.

Additional Readings and General References:

Backus BE, Six AJ, Kelder JC, et al. A prospective validation of the HEART score for chest pain patients in the emergency department. *Int J Cardiol*. 2013;168(3):2153-2158.

Body R, Cook G, Burrows G, Carley S, Lewis PS. Can emergency physicians “rule in” and “rule out” acute myocardial infarction with clinical judgement? *Emerg Med J*. 2014;31(11): 872-876.

Hess EP, Perry JJ, Calder LA, et al. Prospective validation of a modified thrombolysis in myocardial infarction risk score in emergency department patients with chest pain and possible acute coronary syndrome. *Acad Emerg Med*. 2010;17(4):368-375.

Mahler, SA, Riley RF, Hiestand BC, et al. The HEART pathway randomized trial: Identifying emergency department patients with acute chest pain for early discharge. *Circ Cardiovasc Qual Outcomes*. 2015;8:195-203. doi:10.1161/CIRCOUTCOMES.114.001384.

Scheuermeyer FX, Wong H, Yu E, et al. Development and validation of a prediction rule for early discharge of low-risk emergency department patients with potential ischemic chest pain. *CJEM.* 2014;16(2):106-119.

PICO Question 2: *In patients with suspected ischemic cardiac chest pain what is the diagnostic utility of achieving pain relief from nitrates in determining if the acute chest pain is of cardiac origin?*

Return to Initial Decision Making
Return to Order Set Components - Medications

Population, Patient or Problem: Adults presenting with suspected ischemic cardiac chest pain
Intervention, Prognostic Factor, Exposure: nitroglycerin
Comparison: placebo
Outcome: pain relief, selective effectiveness for ischemic chest pain or angina equivalent
Design: RCTs or systematic reviews

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. The NICE guidelines were searched.

Clinical Recommendation: We recommend that relief with nitroglycerin should not be used as a diagnostic tool to determine whether chest pain is cardiac or non-cardiac in origin. Pain relief with nitroglycerin is not indicative of chest pain of cardiac origin, nor is lack of pain relief with nitroglycerin indicative of non-cardiac origin.

No systematic review could be identified. Four observational cohorts found that relief with nitroglycerin was not a reliable diagnostic tool for determining cardiac chest pain.[1-4] The recommend that the relief of chest pain with nitroglycerin should NOT be used to guide diagnosis.

Quality of Evidence: Moderate, Grade B.

Strength of Recommendation: Grade 1. Strong.

References:
1. 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. *Ann Emerg Med.* 2005;45(6):581-585.
2. Henrikson CA, Howell EE, Bush DE, et al. Chest pain relief by nitroglycerin does not predict active coronary artery disease. *Ann Intern Med.* 2003;139:979-986.
3. Shry EA, Dacus J, Van De Graaff E, Hjelkrem M, Stajduhar KC, Steinhubl SR. Usefulness of the response to sublingual nitroglycerin as a predictor of ischemic chest pain in the emergency department. *Am J Cardiol.* 2002;90(11):1264-1246.
4. 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? *CJEM*. 2006;8(3):164-169.

PICO Question 3: *In adult patients with suspected ischemic cardiac chest pain what is the value of aspirin prior to a confirmed diagnosis?*

Return to Initial Decision Making

Population, Patient or Problem: Adults presenting with suspected ischemic cardiac chest pain
Intervention, Prognostic Factor, Exposure: aspirin
Comparison: placebo
Outcome: 30 day morbidity, mortality, safety, GI bleeding
Design: RCTs or systematic reviews

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. The NICE guidelines were searched.

Clinical Recommendation: There is insufficient evidence of benefit from routine administration of ASA for all ED patients with undifferentiated chest pain. Depending on cost and workflow constraints, it may be reasonable to withhold ASA until a diagnosis of ACS is made.

No systematic reviews or trials identified. The NICE guidelines suggest that aspirin should only be given if the patient's chest pain is likely to be stable angina until a diagnosis is made.

Although the evidence for ASA in the treatment of confirmed ACS is well-established, there is insufficient evidence to support routine administration of ASA in patients with undifferentiated chest pain. ASA administration in all patients likely poses little risk and may mitigate the risk of omitting ASA in patients with confirmed ACS. However, other strategies to ensure ASA administration in confirmed ACS patients may be similarly successful.

Quality of Evidence: Very Low, Grade D. Unable to identify and reviews or trials to support the recommendations made in identified reviews.

Strength of Recommendation: Insufficient evidence.

Additional Readings and General References:

Chest pain of recent onset: Assessment and diagnosis of recent onset chest pain or discomfort of suspected cardiac origin. National Institute for Health and Care Excellence Web site. http://www.nice.org.uk/guidance/CG95. Published March 2010. Accessed July 6, 2015.

PICO Question 4: *In adult patients with suspected ischemic cardiac chest pain what is the preferred troponin test to rule out AMI?*

Return to Initial Decision Making

Population, Patient or Problem: Adults presenting with suspected ischemic cardiac chest pain
Intervention, Prognostic Factor, Exposure: Troponin T, troponin I, highly sensitive troponin tests
Comparison: Previous reference standard
Outcome: sensitivity, specificity in ruling in or ruling out acute coronary syndrome
Design: RCTs or Prospective Observational studies compared to reference standard

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. The NICE guidelines were searched.

Clinical Recommendation: There is insufficient evidence and lack of consensus to make a recommendation regarding which troponin test should be used to rule-in or rule-out ACS. High-sensitivity assays may facilitate more rapid ED decision making and early discharge for low-risk patients. However, optimal outcome-based assay cutoffs have yet to be identified. If used appropriately, conventional (4th generation) and point-of-care troponin assays are adequate for ruling-out or diagnosing AMI.

Quality of Evidence: Very Low, Grade D. We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

Strength of Recommendation: Insufficient evidence.

Additional Readings and General References:

Cullen L, Mueller C, Parsonage WA, et al. Validation of high-sensitivity troponin 1 in a 2-hour diagnostic strategy to assess 30-day outcomes in emergency department patients with possible acute coronary syndrome. *J Am Coll Cardiol*. 2013;62(14):1242-1249.

Kelly AM, Klim S. Does undetectable troponin I at presentation using a contemporary sensitive assay rule out myocardial infarction? A cohort study [published online ahead of print December 31, 2014]. *Emerg Med J*. doi:10.1136/emermed-2014-204442002E.

Ter Avest E, Visser A, Reitsma B, Breedveld R, Wolthuis A. Point-of-care troponinT is inferior to high-sensitivity troponinT for ruling out acute myocardial infarction in the emergency department [published online ahead of print December 22, 2014]. *Eur J Emerg Med*. doi: 10.1097/MEJ.0000000000000225.

PICO Question 5: ***In adult patients with suspected ischemic cardiac chest pain what timing and frequency of troponin testing can safely rule out AMI?***

Return to Initial Decision Making
Return to Order Set Components - Lab Investigations

Population, Patient or Problem: Adults presenting with suspected ischemic cardiac chest pain
Intervention, Prognostic Factor, Exposure: Troponin T, troponin I, highly sensitive troponin tests (timing and repeats)
Comparison: Previous reference standard
Outcome: sensitivity, specificity in ruling in or ruling out acute coronary syndrome
Design: RCTs or Prospective Observational studies compared to reference standard

Search Strategy: Cochrane library, Medline and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation:

The answer depends on the type of Troponin assay used and the cutoff values used to either rule-in or rule-out AMI.

High-sensitivity Troponin T: We recommend that a high-sensitivity troponin level should be measured as soon as practicable after ED arrival in patients determined by ED staff to be at high risk of ACS. Some evidence from non-randomized studies suggests that an algorithm measuring change in high-sensitivity cardiac troponin T from presentation to either 1-2 hours afterwards is effective in safely ruling in/out acute MI.

AMI may be ruled out at ED arrival in patients with an undetectable high-sensitivity Troponin T; or in patients with normal ECG, low-risk clinical assessment (HEART Score <3, TIMI 0) and a baseline high-sensitivity Troponin T <14ng/L; or in patients with a baseline high-sensitivity Troponin T level <12ng/L AND a change of no more than 3 ng/L within one hour after ED arrival.

Patients with an abnormal ECG, moderate-high risk clinical assessment (HEART Score 4+, TIMI 1+) or initial high-sensitivity Troponin T levels greater than 3 ng/L at ED arrival require further evaluation with serial high-sensitivity troponins at 2-4 hour intervals.

Conventional (4th generation) Troponin T or I: We recommend that a conventional troponin T or I assay should be performed at ED arrival and again at least 6-8 hours after the onset of symptoms in moderate to high-risk patients. The sensitivity of conventional troponin T does not exceed 90% until 8-10 hours from the onset of symptoms, and the sensitivity of conventional troponin I does not exceed 90% until greater than 6 hours from the onset of symptoms.

The guidelines from the American College of Cardiology/American Heart Association (ACC/AHA) recommend troponin levels be assessed upon arrival for patients with chest discomfort consistent with acute coronary syndrome. In patients who are negative for cardiac markers, another test should be completed within 6-12 hours.

Some low-risk patients may have AMI ruled out sooner using conventional Troponin T or I. Recent studies have shown that ACS can be ruled out in patients with two normal conventional

Tn assays performed two hours apart, in combination with a normal ECG and low-risk clinical preciction tool (HEART score 0-3, TIMI 0 or ruled out using the new Vancouver Chest Pain Rule).[1-4] However, the results of these studies can only be applied in settings using the same troponin assays as the studies in which these diagnostic algorithms were derived and validated.

Point of Care Troponin T or I assays: Qualitative (troponin T or I) and quantitative (troponin I only) point-of-care tests have sensitivities similar to the conventional assays, and vary between manufacturer. AMI cannot be excluded in low-risk patient without a point-of-care assay performed 6-12 hours after onset of symptoms, depending on the point-of-care test being used. A Health Technology Assessment by the Canadian Agency for Drugs and Technology in Health examining the cost-effectiveness and utility of point-of-care troponin assays is expected to be completed by mid-2015.

Quality of Evidence: For lab based testing (ie not Point-of Care), the level of evidence is High, Grade A. Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect. The available studies were non-randomized.

Strength of Recommendation: Grade 1, Strong.

References:

1. Scheuermeyer FX, Wong H, Yu E, et al. Development and validation of a prediction rule for early discharge of low-risk emergency department patients with potential ischemic chest pain. *CJEM*. 2014;16(2):106-119
2. Than M, Cullen L, Reid CM, et al. A 2-h diagnostic protocol to assess patients with chest pain symptoms in the Asia-Pacific region (ASPECT): a prospective observational validation study. *Lancet.* 2011;377(9771):1077-1084.
3. Backus BE, Six AJ, Kelder JC, et al. Chest pain in the emergency room: a multicenter validation of the HEART Score. *Crit Pathw Cardiol*. 2010;9(3):164-169.
4. Backus BE, Six AJ, Kelder JC, et al. A prospective validation of the HEART Score for chest pain patients in the emergency department. *Int J Cardiol*. 2013;168(3):2153-2158.

Additional Readings and General References:

Amsterdam DA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;130:e344-426.

Chest pain of recent onset: Assessment and diagnosis of recent onset chest pain or discomfort of suspected cardiac origin. National Institute for Health and Care Excellence Web site. http://www.nice.org.uk/guidance/CG95. Published March 2010. Accessed July 6, 2015.

Ebell MH, Flewelling D, Flynn CA. A systematic review of troponin T and I for diagnosing acute myocardial infarction. *J Fam Pract*. 2000;49(6):550-556.

Irfan A, Reichlin T, Twerenbold R, et al. Early diagnosis of myocardial infarction using absolute and relative changes in cardiac troponin concentrations. *Am J Med*. 2013;126(9):781-788.

Reichlin T, Cullen L, Parsonage WA, et al. Two-hour algorithm for triage toward rule-out and rule-in of acute myocardial infarction using high-sensivity cardiac troponin T [published online

ahead of print November 13, 2014]. *Am J Med*. 2015;128(4):369-379.e4. doi: 10.1016/j.amjmed.2014.10.032.

PICO Question 6: *In adult patients presenting to the ED with suspected cardiac chest pain is supplemental O2 beneficial in non-hypoxemic patients?*

Return to Initial Decision Making
Return to Order Set Components – Respiratory Care

Population, Patient or Problem: Adults with suspected cardiac chest pain
Intervention, Prognostic Factor, Exposure: Supplemental O2 to maintain O2 Sat greater than or equal to 94%
Comparison: No supplemental O2
Outcome: 30 day morbidity, mortality, safety
Design: RCTs or systematic reviews.

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation:
2015 Canadian Heart and Stroke guidelines and American Heart Association (AHA) guidelines do not mandate supplemental oxygen administration for normoxic patients with undifferentiated chest pain.[1,2] The AHA/ACC 2014 guidelines recommend that supplemental oxygen only be administered to patients with diagnosed with ACS who have an oxygen saturation less than 90% or are in respiratory distress.[3] 2015 guidelines do not mandate supplemental oxygen administration for normoxic patients with undifferentiated chest pain.

Recent randomized, controlled trials compared room air to supplemental oxygen in patients with confirmed STEMI and normal oxygen saturation, and found higher risk of arrhythmia, re-infarction and larger total infarct size in patients administered supplemental O2. Additional evidence suggests that supplemental oxygen may increase coronary vascular resistance, reduced coronary blood flow and increased mortality.[4]

An update of the Cochrane review on oxygen therapy for AMI published in December 2016 reiterated that there is “no evidence from randomized controlled trials to support the routine use of oxygen on people with AMI, and we cannot rule out harmful effect.[3]

Quality of Evidence: Moderate, Grade B . There is no evidence of benefit of supplemental O2 in ACS patients with normal oxygen saturation, and some evidence of harm.

Strength of Recommendation: Grade 2, Weak.

References:

1. Amsterdam DA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;130:e344-e426.
2. O’Connor RE, Al Ali AS, Brady WJ, Ghaemmaghami CA, Menon V, Wlsford M, Shuster M. Part 9: Acute coronary syndromes 2015 American heart association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation* 2015;132[suppl 2]:S483-S500.

3. Stub D, Smith K, Bernard S, et al. Air versus oxygen in ST-segment elevation myocardial infarction. *Circulation*. 2015;131(24):2143-2150. doi: 10.1161/CIRCULATIONAHA.114.014494.
4. Cabello JC, Burls A, Emparanza JI, Bayliss SE, Quinn T. Oxygen therapy for acute myocardial infarction. Cochrane Database Systems Rev. 19 Dec 2016 | DOI: 10.1002/14651858.CD007160.pub4

PICO Question 7: ***In adult patients presenting to the ED with suspected cardiac chest pain but low to moderate risk for ischemic cardiac disease is there a benefit to continuous cardiac monitoring?***

Return to Initial Decision Making
Return to Order Set Components – General Care

Population, Patient or Problem: Adults with suspected cardiac chest pain at low to moderate risk
Intervention, Prognostic Factor, Exposure: continuous cardiac monitoring
Comparison: no monitoring
Outcome: 30 day morbidity, mortality, safety, admission rates
Design: RCTs or systematic reviews.

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation: Despite limited evidence, we suggest continuous 1- or 3-lead monitoring for high-risk patients or patients with ongoing symptoms.

The ACC/AHA 2014 guidelines state that continuous 12-lead ECG monitoring is a reasonable alternative to serial monitoring in patients with a normal initial ECG.[1] However, there is no evidence to suggest benefit from continuous single- or triple-lead cardiopulmonary monitoring in low/moderate risk patients without active symptoms.

Quality of Evidence: Low, Grade D.

Strength of Recommendation: Grade 2, Weak.

References:

1. Amsterdam DA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation. 2014;130:e344-e426.

PICO Question 8: ***In adult patients with reproducible chest wall pain equivalent to the pain they presented to the ED with, can AMI be safely ruled out without the need for troponin testing?***

Return to Initial Decision Making

Population, Patient or Problem: Adults presenting with reproducible chest wall pain
Intervention, Prognostic Factor, Exposure: Physical examination +/- standard labs and chest x-ray
Comparison: Troponin protocol to R/O AMI
Outcome: sensitivity, specificity, safety, prognosis
Design: Prospective Observational studies

Search Strategy: Cochrane library and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation: There is insufficient evidence and lack of consensus to make a recommendation regarding whether ACS can be safely ruled out solely by reproducibility upon palpation. The Vancouver Chest Pain Rule incorporates reproducibility by palpation, but only in those with negative biomarkers at 2h after ED arrival.

No systematic reviews or guidelines were available.

Quality of Evidence: Weak, Grade C.

Strength of Recommendation: Insufficient evidence.

Additional Readings and General References:
Scheuermeyer FX, Wong H, Yu E, et al. Development and validation of a prediction rule for early discharge of low-risk emergency department patients with potential ischemic chest pain. *CJEM.* 2014;16(2):106-119.

PICO Question 9: ***In adult patients with suspected ischemic cardiac chest pain what is the utility of a chest x-ray in patients with no respiratory disease or symptoms?***

Return to Order Set Components – Diagnostic Investigations

Population, Patient or Problem: Adults presenting with suspected ischemic cardiac chest pain
Intervention, Prognostic Factor, Exposure: Routine standard chest x-ray
Comparison: Chest x-ray based on specific indications (e.g. shortness of breath, signs of heart failure, etc.)
Outcome: sensitivity, specificity for identifying meaningful abnormality
Design: RCTs or Prospective Observational studies compared to reference standard

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation: We suggest that chest x-rays should be limited to patients presenting with chest pain with shortness of breath, history of smoking, lung auscultation findings, and age greater than 55 yrs.

The NICE guidelines suggest that a chest x-ray should be considered to exclude pulmonary oedema, pneumothorax or pneumonia. The NICE guidelines also state that chest x-rays should only be considered if other diagnoses, such as a lung tumour, are suspected.[1] The ICSI state that chest x-rays may add value to patient evaluation, but does not provide any other additional details.[2]

Several studies have found limited or no use of chest x-rays for patients presenting with symptoms suggestive of congestive heart failure.[3,4] One study developed a clinical decision rule, stating that chest x-rays should not be provided to patients if they have no history of congestive heart failure, no smoking history, and no abnormalities on lung auscultation.[5] A follow-up study of a different patient population did not validate this clinical decision rule, and the rule had to be modified, stating that patients with no shortness of breath, no history of smoking, no lung auscultation findings, and age of less than 55 yrs old, did not require chest x-rays.[6] A study by Goldschlager et al[7], recommends that the clinical decision rule developed by Poku needs to be modified further, as the guidelines were not 100% sensitive.

Quality of Evidence: Moderate, Grade B. We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Strength of Recommendation: Grade 2, Weak.

References:

1. Chest pain of recent onset: Assessment and diagnosis of recent onset chest pain or discomfort of suspected cardiac origin. National Institute for Health and Care Excellence Web site. http://www.nice.org.uk/guidance/CG95. Published March 2010. Accessed July 6, 2015.
2. Davis T, Bluhm J, Burke R, et al. Institute for Clinical Systems Improvement. Diagnosis and Treatment of Chest Pain and Acute Coronary Syndrome (ACS). https://www.icsi.org/_asset/ydv4b3/ACS-Interactive1112b.pdf. Updated November 2012. Accessed July 6, 2015.
3. Ng J, Taylor DM. Routine chest radiography in uncomplicated suspected acute coronary syndrome rarely yields significant pathology. *Emerg Med J*. 2008;25(12):807–810.
4. Al Zadjali N, Al-Senawi R, Al Reesi A, Al-Zakwani I, Nemeth J, Perry JJ. Predictors of positive chest radiography in non-traumatic chest pain in the emergency department. *Oman Med J.* 2009;24(1):22–26.
5. Hess EP, Perry JJ, Ladouceur P, Wells GA, Stiell IG. Derivation of a clinical decision rule for chest radiography in emergency department patients with chest pain and possible acute coronary syndrome. *CJEM*. 2010;12(2):128-134.
6. Poku JK, Bellamkonda-Athmaram VR, Bellolio F, Nestler DM, Stiell IG, Hess EP. Failure of prospective validation and derivation of a refined clinical decision rule for chest radiography in emergency department patients with chest pain and possible acute coronary syndrome. *Acad Emerg Med.* 2012;19(9):1004-1010.
7. Goldschlager R, Roth H, Solomon J, et al. Validation of a clinical decision rule: chest x-ray in patients with chest pain and possible acute coronary syndrome. *Emerg Radiol.* 2014;21(4):367-372.

PICO Question 10: ***In adult patients with suspected ischemic cardiac chest pain, which patients would benefit from non-aspirin antiplatelet therapy, and which medication has the best benefit/harm profile?***

Return to Order Set Components – Medications

Population, Patient or Problem: Adults presenting with suspected ischemic cardiac chest pain
Intervention, Prognostic Factor, Exposure: clopidogrel or ticagrelor
Comparison: aspirin
Outcome: 30 day morbidity, mortality, safety, GI bleeding
Design: RCTs or systematic reviews

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation: There is insufficient evidence to recommend routine use of non-aspirin antiplatelet agents in patients with suspected ischemic chest pain, before a diagnosis of ACS has been made. Patients with ASA allergies may be offered clopidogrel or ticagrelor.

Unable to locate any studies or reviews which compared non-aspirin antiplatelet therapy (such as clopidogrel or ticagrelor) to aspirin in reducing morbidity in adult patients with suspected ischemic cardiac chest pain. This suggests that patients who cannot take ASA due to hypersensitivity or major gastrointestinal intolerance should receive other antiplatelet drugs, like clopidogrel or ticagrelor, rather than aspirin. The updated guidelines of the Canadian Cardiovascular society reported ticagrelor achieves a more rapid and greater effect than clopidogrel.[1] The ICSI guidelines recommends that in patients with high risk of ACS, and where an initial invasive strategy is planned, a loading dose of clopidogrel or prasugrel should be given as soon as possible prior to PCI in addition to aspirin.[2] If clopidogrel is not given before PCI, prasugrel or ticagrelor should be added at the time of PCI. In patients at high risk of ACS where initial non-invasive strategy is planned, a loading dose of clopidogrel or ticagrelor should be given with aspirin as soon as possible.

Quality of Evidence: Very Low, Grade D.

Strength of Recommendation: Insufficient evidence.

References:

1. Tanguay JF, Bell AD, Ackman ML, et al. Focused 2012 update of the Canadian Cardiovascular Society guidelines for the use of antiplatelet therapy. *Can J Cardiol*. 2013; 29(11):1334-1345.
2. Davis T, Bluhm J, Burke R, et al. Institute for Clinical Systems Improvement. Diagnosis and Treatment of Chest Pain and Acute Coronary Syndrome (ACS). https://www.icsi.org/_asset/ydv4b3/ACS-Interactive1112b.pdf. Updated November 2012. Accessed July 6, 2015.

Additional Readings and General References:

Braunwald E, Antman EM, Beasley JW, et al. ACC/AHA guidelines for the management of patients with unstable angina and non-ST-segment elevation myocardial infarction: executive summary and recommendations. A report of the American College of Cardiology/American

Heart Association task force on practice guidelines (committee on the management of patients with unstable angina). *Circulation.* 2000;102(10):1193-1209.

PICO Question 11: *In adult patients presenting to the ED with low to moderate risk for ischemic cardiac disease who had normal or unchanging ECGs and negative repeat troponins what is the optimal outpatient timing for provocative testing?*

Return to Disposition Planning

Population, Patient or Problem: Adults with low to moderate risk for ischemic cardiac disease based on normal or unchanged ECG and normal ED troponins
Intervention, Prognostic Factor, Exposure: Provocative cardiac testing
Comparison: timing (same day, next day, within 72 hours, within 1 week)
Outcome: sensitivity, specificity in ruling in or ruling out acute coronary syndrome
Design: RCTs or Prospective Observational studies compared to reference standard.

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation: We suggest that outpatient testing for patients with low risk take place within 7 days of ED discharge and within 72 hours of ED discharge for moderate risk patients. Indirect evidence from observational studies suggests that the optimal timing for outpatient provocative testing for low to moderate risk patients is within 2-7 days from ED discharge.

The American College of Cardiology/American Heart Association practice guidelines suggests that patients with suspected acute coronary syndrome where ischemic heart disease is suspected or present, with normal ECG and normal cardiac biomarkers, a stress test should be performed within 72 hours of discharge from the ED.[1] However, in multiple observational studies of ED patients with chest pain, the majority of adverse cardiac events occurred within 1 week of their index presentation, suggesting that outpatient provocative testing for patients with low to moderate CAD risk should be performed within 2-7 days of their index ED visit.

Quality of Evidence: Very Low, Grade D.

Strength of Recommendation: Grade 2, Weak.

References:

1. Amsterdam DA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;130:e344-426.

PICO Question 12: ***In adult patients presenting to the ED with low to moderate risk for ischemic cardiac disease who had normal or unchanging ECGs and negative repeat troponins what is the optimal modality for provocative testing?***

Return to Disposition Planning

Population, Patient or Problem: Adults with low to moderate risk for ischemic cardiac disease based on normal or unchanged ECG and normal ED troponins
Intervention, Prognostic Factor, Exposure: stress MIBI vs stress echocardiography vs other
Comparison: EST
Outcome: sensitivity, specificity in ruling in or ruling out acute coronary syndrome
Design: RCTs or Prospective Observational studies compared to reference standard.

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation: We suggest that the choice of stress test appears to depend on patient characteristics and their ability to exercise, or have an interpretable ECG. Patients with an interpretable ECG and can exercise should undergo exercise stress testing. Patients who are unable to exercise should undergo stress imaging strategies such as Myocardial Perfusion Imaging (MPI) or stress echocardiography. Stress electrocardiography appears to not be as useful in women compared to stress echocardiography. Older patients may benefit from stress imaging strategies or pharmacological stress testing due to their trouble performing exercise and inconclusive ECGs. Dobutamine-atropine stress echocardiography appears to be more cost-effective than electrocardiographic exercise testing.

The ACCF/AHA guidelines recommend that in patients with suspected ischemic heart disease with normal ECG and cardiac biomarkers, a stress test (exercise or pharmacological) to provoke ischemia should be performed in the ED, chest pain unit, or outpatient services within 72 hours as an alternative to inpatient admission.[1] The choice of stress test should be based on the patients resting ECG, their ability to perform exercise, local expertise, and the technologies available. Patients who are capable of exercise and free of confounding features on baseline ECG, such as bundle-branch block, LV hypertrophy, or paced rhythms, can be testing using exercise stress testing.

Pharmacological stress testing with imaging is recommended when there are physical limitations prohibiting exercise testing or patients with an uninterpretable baseline ECG. Regarding gender, the ACCF/AHA guidelines state that the current evidence suggests that exercise electrocardiography is less predicative for women than in men due to the lower pretest probability of CAD.[1,2] In a study by Marwick et al,[3] sensitivity of exercise echocardiography (81 ±4%) was similar to exercise electrocardiography (77 ± 3%), but specificity of exercise echocardiography (80±3%) was higher than in exercise electrocardiography (56 ± 4%) in detecting CAD in women. Treadmill exercise combined with the Duke Treadmill score provides an accurate diagnosis and prognosis for men and women.[4] The ACCF/AHA guidelines states that image-enhanced testing has similar prognostic value in women as in men and recommends that non-invasive testing in women with CAD are UA/NSTEMI are similar to those in men (level of evidence B according to Anderson et al).[1] The ACCF/AHA guidelines do not recommend a particular stress test over the other.

The ACCF/AHA guidelines state that older patients often have trouble performing standardized exercise stress tests.[1] In addition, due to a higher rate of comorbidities and other pre-existing resting ECG abnormalities, standard ECG's are often inconclusive. Pharmacological stress testing should be used instead. A retrospective cohort found that low-intermediate risk patients younger than 40 yrs old, with negative ECG and troponin and no history of CAD have a less than 1% risk for ACS or other major cardiac events within 30 days after discharge, and that there is no benefit of admission or stress testing in those patients.[5]

A narrative review depends on several factors including patient characteristics, availability of different modalities, and expertise of the centre.[6] Patients who are able to exercise and have a interpretable ECG (no left bundle-branch block, ventricular pacing, LV hypertrophy, greater than or equal to 1-mm ST-segment depression, or use of digoxin) should undergo exercise treadmill ECG test. Exercise ECG is quicker to complete and has lower costs compared to imaging stress tests. Patients who are unable to exercise or have an uninterpretable ECG should undergo imaging stress tests such as MPI or stress echocardiography.

One retrospective cohort study found that contrast stress-echocardiography successfully predicted the occurrence of acute coronary syndromes within 1 year, while exercise-electrocardiography could not.[7] Patients who underwent exercise-electrocardiography tended to be younger and had a lower TIMI risk score than patients in the contrast stress-echocardiography group. Patients in the stress-echocardiography group had more cardiovascular risk factors and medication use. In comparison, two randomized controlled trials randomized patients to either receive stress echocardiography or exercise ECG.[8,9] The study found stress echocardiography to be superior to exercise ECG for risk stratification for patients with suspected acute coronary syndromes, resulting in less diagnostic uncertainty. According to Jeetley et al,[8] patients undergoing stress cardiography were significantly more likely to be low-probability CAD patients, and significantly fewer patients were considered to be of intermediate risk post-test probability of CAD compared to patients in the exercise ECG group. Jeetley et al reported that significantly more patients undergoing stress echocardiography were considered to be of low post-test risk for CAD.[9] Stress echocardiography was considerably more effective in reducing the number of patients considered to be at intermediate risk than exercise ECG. More patients in the exercise ECG group were considered to be of high post-test risk compared to the stress echocardiography group.

A RCT compared the use of dobutamine-atropine stress echocardiography (DASE) and electrocardiographic exercise testing (EET) in patients presenting to the ED with chest pain.[10] Overall, among patients who were discharged with non-ischemic acute chest pain, those who underwent EET received significantly more additional testing within 2 months after discharge than patients in the DASE group. As a result, costs were also significantly higher in the EET group than the DASE group.

Quality of Evidence: Low, Grade C. Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.

Strength of Recommendation: Grade 2, Weak.

References:

1. Anderson JL, Adams CD, Antman EM, et al. 2012 ACCF/AHA focused update incorporated into the ACCF/AHA 2007 guidelines for the management of patients with unstable

angina/non-ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation.* 2013;127(23):e663-e828. doi: 10.1161/CIR.0b013e31828478ac.
2. Fihn SD, Gardin JM, Abrams J, et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the diagnosis and management of patients with stable ischemic heart disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American College of Physicians, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2012;60(24):e44-e164. doi: 10.1016/j.jacc.2012.07.013.
3. Marwick TH, Anderson T, Williams J et al. Exercise echocardiography is an accurate and cost-efficient technique for detection of coronary artery disease in women. J Am Coll Cardiol 1995; 26(2):335-41.
4. Alexander KP, Shaw LJ, Shaw LK, Delong ER, Mark DB, Peterson ED. Value of exercise treadmill testing in women. *J Am Coll Cardiol*. 1998;32(6):1657-1664.
5. Napoli AM, Tran S, Wang J. Low-risk chest pain patients younger than 40 years do not benefit from admission and stress testing. *Crit Pathw Cardiol*. 2013;12(4):201-203.
6. Dave DM, Ferencic M, Hoffmann U, Udelson JE. Imaging techniques for the assessment of suspected acute coronary syndromes in the emergency department. *Curr Probl Cardiol.* 2014;39(7):191-247.
7. Gaibazzi N, Reverberi C, Badano L. Usefulness of contrast stress-echocardiography or exercise-electrocardiography to predict long-term acute coronary syndromes in patients presenting with chest pain without electrocardiographic abnormalities or 12-hour troponin elevation. *Am J Cardiol.* 2011;107(2):161-167.
8. Jeetley P, Burden L, Senior R. Stress echocardiography is superior to exercise ECG in the risk stratification of patients presenting with acute chest pain with negative Troponin. *Eur J Echocardiogr*. 2006;7(2):155-164.
9. Jeetley P, Burden L, Stoykova B, Senior R. Clinical and economic impact of stress echocardiography compared with exercise electrocardiography in patients with suspected acute coronary syndrome but negative troponin: a prospective randomized controlled study. *Eur Heart J*. 2007;28(2):204-211.
10. Nucifora G, Badano LP, Sarraf-Zadegan N, et al. Comparison of early Dobutamine Stress Echocardiography and exercise electrocardiographic testing for management of patients presenting to the emergency department with chest pain. *Am J Cardiol*. 2007;100(7):1068-1073.

Additional Readings and General References:

Amsterdam DA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;130:e344-e426.

PICO Question 13: ***In adult patients presenting to the ED with chest pain considered suspicious for ischemic cardiac disease can we safely identify very low risk patients not requiring referral for outpatient provocative testing?***

Return to Disposition Planning

Population, Patient or Problem: Low risk adults with chest pain initially suspicious for ischemic cardiac pain
Intervention, Prognostic Factor, Exposure: Evidence based risk stratification strategy
Comparison: Clinical judgment
Outcome: sensitivity, specificity in ruling in or ruling out acute coronary syndrome
Design: RCTs or Prospective Observational studies compared to reference standard

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation: We suggest that patients who are younger than 40, with normal ECG and are negative for cardiac biomarkers maybe suitable for discharge from the ED without referral for outpatient provocative testing.

Three retrospective observational study were identified.[1-3] These studies found that provocative testing had limited use in identifying acute coronary syndrome in patients younger than 40 yrs old, normal ECG results, and negative cardiac biomarker results.

The new Vancouver Chest pain rule may be useful in identifying low risk patients that can be discharged from the ED without the need for provocative testing.[4] This prospective cohort study found that patients identified by the Vancouver chest pain rule as being low risk, (non ischemic ECG, no history of acute coronary syndrome or nitrate use, less than 50 years old, pain reduced by palpation, and non-radiating pain, in addition to normal troponin levels at 2 hours after presentation) could be safely discharged within 2 hours from the ED without provocative cardiac testing.

Another prospective observational study found that among patients with signs or symptoms of acute coronary syndrome with normal ECG and negative for biomarkers, the rates of diagnosis of coronary artery disease after routine provocative cardiac testing was uncommon with high rates of false-positives.[5]

The 6-week adverse cardiac event risk for ED chest pain patients with a HEART score of 0-3 was 1.6%. These patients may be safely discharged to primary care follow-up without outpatient investigations. Patients with a moderate-risk HEART Score (4-7) had a 6-week adverse event risk of 12-17%. Although it may be reasonable to discharge moderate risk patients with negative biomarkers to outpatient provocative testing, no evidence exists to support this strategy.

Quality of Evidence: Moderate, Grade B. We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Strength of Recommendation: Grade 2, Weak.

References:
1. Dawson M, Youngquist S, Bledsoe J, et al. Low-risk young adult patients with chest pain may not benefit from routine cardiac stress testing: A Bayesian analysis. *Crit Pathw Cardiol*. 2009; 9(3):170-173.
2. Hermann LK, Weingart SD, Duvall WL, Henzlova MJ. The limited utility of routine cardiac stress testing in emergency department chest pain patients younger than 40 years. *Ann Emerg Med.* 2009; 54(1):12-16.
3. Scott AC, Bilesky J, Lamanna A, et al. Limited utility of exercise stress testing in the evaluation of suspected acute coronary syndrome in patients aged less than 40 years with intermediate risk features. *Emerg Med Australias*. 2014;26(2):170-176.
4. Scheuermeyer FX, Wong H, Yu E, et al. Development and validation of a prediction rule for early discharge of low-risk emergency department patients with potential ischemic chest pain. *CJEM.* 2014;16(2):106-119.
5. Hermann LK, Newman DH, Pleasant WA, et al. Yield of routine provocative cardiac testing among patients in an emergency department-based chest pain unit. *JAMA Intern Med*. 2013;173(12):1128-1133.

Additional Readings and General References:
Mahler, SA, Riley RF, Hiestand BC, et al. The HEART pathway randomized trial: Identifying emergency department patients with acute chest pain for early discharge. *Circ Cardiovasc Qual Outcomes*. 2015;8:195-203. doi:10.1161/CIRCOUTCOMES.114.001384.

PICO Question 14: *In adult patients presenting to the ED with low to moderate risk for ischemic cardiac disease who had normal or unchanging ECGs and negative repeat troponins being discharged for follow up provocative testing what medications should they receive?*

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Population, Patient or Problem: Adults with low to moderate risk for ischemic cardiac disease based on normal or unchanged ECG and normal ED troponins
Intervention, Prognostic Factor, Exposure: newer anti platelet meds +/- nitroglycerin
Comparison: ASA only
Outcome: 30 day morbidity, mortality, safety, GI bleeding
Design: RCTs or systematic reviews.

Search Strategy: Cochrane library, Medline, and PubMed for systematic reviews and clinical trials. Guidelines were searched.

Clinical Recommendation: There is insufficient evidence and lack of consensus to make a recommendation regarding what ED discharge medications for patients awaiting follow-up provocative testing after discharge from the ED. ASA 80mg OD likely has a positive risk-benefit ratio.

The AHA/ACC guidelines state that nitrates and calcium channel blockers should be withdrawn well before the start of provocative testing.[1] Low risk patients who are referred to outpatient stress testing can receive ASA, sublingual nitroglycerin, and/or beta-blockers while waiting for the results of the stress test.

Quality of Evidence: Very Low, Grade D. We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect. No evidence is provided by the guideline regarding why nitrates and calcium channel blockers should be withdrawn before the start of provocative testing.

Strength of Recommendation: Insufficient evidence.

References:

1. Amsterdam DA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;130:e344-e426.

Appendix B – PICO-D Methodology and GRADE Terminology

Return to Appendix A

Key components of high quality and trustworthy clinical guidance include: i) recommendations that are clearly stated and based on scientific evidence of benefits, harms and where possible, costs, and ii) a guideline rating system that is used to communicate quality and reliability of both the evidence and the strength of its recommendations. In the development of these guidelines, clinical questions were formulated based on the PICO-D format as supported by Sackett[1] and Guyatt[2] in their User's Guide to the Medical Literature to define the clinical question. The GRADE terminology, where possible, is used to address the questions regarding Quality of Evidence and Strength of Recommendations. The components of PICO-D format and the GRADE methodology are described below.

PICO-D

P - Population, Patient, or Problem: This element defines the group of patients or characteristics of the patients.
I - Intervention, Prognostic Factor, Exposure: This element defines the main intervention being considered.
C - Comparison: This element defines the main alternative to compare with the intervention, such as comparison of two drugs or tests, or a medication to no medication or placebo.
O - Outcome: This defines what you are trying to accomplish, measure, improve or affect.
D - Design: The type of question (related to diagnosis, harm/etiology, prognosis, or therapy) will define which study design is best suited to provide evidence to answer the clinical question.

Definitions of Study Types[2,3]

1. **Meta-analysis:** a statistical technique that summarizes the results of several studies in a single weighted estimate, in which more weight is given to results of studies with more events and sometimes to studies of higher quality.
2. **Systematic Review:** attempts to collate all empirical evidence that fits pre-specified eligibility criteria to answer a specific research question using explicit, systematic methods selected with a view to minimizing bias. This provides more reliable findings from which to draw conclusions.[4,5] The key characteristics of a systematic review are: i) clearly stated objectives with pre-defined eligibility criteria for studies; ii) an explicit and reproducible methodology; iii) a systematic search that attempts to identify all studies meeting the eligibility criteria; iv) an assessment of validity for the included studies, (e.g. through the assessment of risk of bias; and v) a systematic synthesis and presentation, of the characteristics and findings of the included studies.[6]
3. **Randomized Controlled Trial (RCTs):** a trial in which participants are randomly assigned to two or more groups: at least one (the experimental group) receiving an intervention that is being tested and another (the comparison or control group) receiving an alternative treatment or placebo. This design allows assessment of the relative effects of interventions.
4. **Controlled Clinical Trial (CCTs):** a trial in which participants are assigned to two or more different treatment groups in a non-randomized or quasi-randomized method. Examples of quasi-randomized allocation are birthdate and medical record numbers.

Studies in which the randomization process is not explicitly stated as randomized are considered CCTs. CCTs are more likely to suffer from bias than RCTs.

5. **Observational Studies:**
    a. **Cohort Study[2]:** an observational study in which a defined group of people (the cohort) is followed over time. The outcomes of people in subsets of this cohort are compared, to examine people who were exposed or not exposed (or exposed at different levels) to a particular intervention or other factor of interest. A prospective cohort study assembles participants and follows them into the future. A retrospective (or historical) cohort study identifies subjects from past records and follows them from the time of those records to the present.
    b. **Case control study:** a study design that examines a group of people who have experienced an event (usually an adverse event) and a group of people who have not experienced the same event, and looks at how exposure to suspect (usually noxious) agents differed between the two groups. This type of study design is most useful for trying to ascertain the cause of rare events, such as rare cancers.
    c. **Case Series:** analysis of series of people with the disease (there is no comparison group in case series).

GRADE Methodology

Whenever possible answers are identified from recent high quality guidelines or high quality systematic reviews and recommendations provided are based on GRADE definitions. Where guidelines or systematic reviews are not available to answer certain questions rapid reviews are undertaken and/or a consensus approach used to try to answer clinically relevant questions. **Only where the evidence is supportive and the benefits clearly outweigh the harm is a "we recommend" strength of recommendation applied.**

Table 1. GRADE Quality of Evidence[2]

High GRADE A	We have high confidence that the true effect lies close to that of the estimate of the effect.
Moderate GRADE B	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low GRADE C	Our confidence in the effect estimate is low: The true effect may be substantially different from the estimate of the effect.
Very low GRADE D	We have very low confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.

Table 2. GRADE Strength of Recommendations[2]	
Strong GRADE 1	Strong recommendation, with desirable effects clearly outweighing undesirable effects/burdens (or vice versa). **Wording of Recommendation:** We recommend in favor of / We recommend against…..
Weak GRADE 2	Weak recommendation, with desirable effects closely balanced with undesirable effects. **Wording of Recommendation:** We suggest in favor of / We suggest against …..
Insufficient evidence or no consensus	**Wording of Recommendation:** There is insufficient evidence or the confidence in the effect estimates is so low that the panel is unable to make a recommendation regarding….

References:

1. Sackett D, Richardson WS, Rosenburg W, Haynes RB. *How to practice and teach evidence based medicine.* 2nd ed. Churchill Livingstone; 1997.
2. Guyatt GH, Oxman AD, Vist GE, et al; for the GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008; 336(7650):924-926.
3. Clinical Questions, PICO & Study Designs: Formulating a Well Built Clinical Question. Dahlgren Memorial Library/ Georgetown University Medical Center. http://researchguides.dml.georgetown.edu/ebmclinicalquestions. Updated February 3, 2015. Accessed January 2015.
4. Antman EM, Lau J, Kupelnick B, Mosteller F, Chalmers TC. A comparison of results of meta-analyses of randomized control trials and recommendations of clinical experts. Treatments for myocardial infarction. *JAMA.* 1992;268(2):240-248.
5. Oxman AD, Guyatt GH. The science of reviewing research. *Ann N Y Acad Sci.* 1993;703:125-133.
6. Higgins JPT, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions.* Version 5.1.0. West Sussex, England: The Cochrane Collaboration and John Wiley & Sons, Ltd; 2008.

Appendix C – Heart Score

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Table 1. HEART Score for Prediction of 6-week Risk of Major Adverse Cardiac Event

Category	Criteria	Scoring
History	Highly Suspicious	2 points
	Moderately Suspicious	1 point
	Slightly/Non-Suspicious	0 points
ECG	Significant ST depression	2 points
	Nonspecific Repolarization	1 point
	Normal	0 points
Age	65 years and older	2 points
	45 – 65 years	1 point
	Less than 45 years	0 points
Risk Factors	3 or more risk factors or history of coronary artery disease	2 points
	1 or 2 risk factors	1 point
	No risk factors	0 points
Troponin	3 times normal limit or greater	2 points
	1 – 3 times normal limit	1 point
	Less than or equal to normal limit	0 points

Score 0-3: 1.7% 6 week MACE risk. Suitable for ED Discharge

Score 4-6: 12-17% 6 week MACE risk. Consider admission or discharge to urgent outpatient follow-up

Score 7+: 50% 6 week MACE risk. Suggest admission and urgent cardiac investigations

[a.] Adapted from Backus et al.[1,2]

For HEART Score calculator: **https://www.mdcalc.com/heart-score-major-cardiac-events**

References:

1. Backus BE, Six AJ, Kelder JC, et al. Chest pain in the emergency room: a multicenter validation of the HEART Score. *Crit Pathw Cardiol*. 2010;9(3):164-169.
2. Backus BE, Six AJ, Kelder JC, et al. A prospective validation of the HEART Score for chest pain patients in the emergency department. *Int J Cardiol*. 2013;168(3):2153-2158.

Appendix D – Patient Education and Discharge Material

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D1. Healthwise patient education – Angina:
https://myhealth.alberta.ca/health/AfterCareInformation/pages/conditions.aspx?HwId=uh3871

D2. Healthwise patient education – Chest Pain:
https://myhealth.alberta.ca/health/AfterCareInformation/pages/conditions.aspx?HwId=ud3413

Appendix E – Clinical Working Group Membership

We would like to acknowledge the contributions of the Provincial Clinical Knowledge Working Group members as follows. Your participation and time spent is appreciated.

Emergency Department Suspected Cardiac Chest Pain Knowledge Topic Working Group Membership

Name	Title	Role	Zone
Knowledge Lead			
Micheal Bullard	Physician	Knowledge Lead	Provincial
Topic Lead			
Andrew McRae	Physician	Topic Lead	Provincial
Working Group Members			
Ali Kirkham	Physician	Working Group Member	Edmonton Zone
Brian Holroyd	Physician	Working Group Member	Edmonton Zone
Chris Hall	Physician	Working Group Member	Calgary Zone
Dan Banmann	Physician	Working Group Member	South Zone
Eddy Lang	Physician	Working Group Member	Calgary Zone
Harvey Woytiuk	Physician	Working Group Member	North Zone
Jenn Pritchard	Physician	Working Group Member	Edmonton Zone
Lyle Thomas	Physician	Working Group Member	Central Zone
Ni Lam	Physician	Working Group Member	Edmonton Zone
Pat San Augustin	Physician	Working Group Member	Edmonton Zone
Richard Martin	Physician	Working Group Member	North Zone
Sam Chow	Physician	Working Group Member	Edmonton Zone
Shawn Dowling	Physician	Working Group Member	Calgary Zone
Simon Ward	Physician	Working Group Member	Central Zone
Katherine Smith	Physician	Working Group Member	Edmonton Zone
Alexis Mageau	Registered Nurse	Working Group Member	Calgary Zone
Bonnie Niebergall	Registered Nurse	Working Group Member	South Zone
Jennine Desmarais	Registered Nurse	Working Group Member	North Zone
Laura Fowler	Registered Nurse	Working Group Member	Central Zone
Margaret Dymond	Registered Nurse	Working Group Member	Edmonton Zone
Maria Janik	Registered Nurse	Working Group Member	Edmonton Zone
Monique Fernquist	Registered Nurse	Working Group Member	Provincial
Shelly Lynn Franklin	Registered Nurse	Working Group Member	North Zone
Thora Skeldon	Registered Nurse	Working Group Member	Central Zone
Multidisciplinary			
Andrew Howarth	Physician	Content Expert	Calgary Zone
Blair O'Neil	Physician	Content Expert	Edmonton Zone
Kevin Bainey	Physician	Content Expert	Edmonton Zone
Bill Anderson	Physician - Diagnostic Imaging Representative	Content Expert	Provincial
Stafford Dean	DIMR representative	Content Expert	Provincial
James Wesenberg	Laboratory Representative	Content Expert	Provincial
Steve Freriks	Pharmacy Representative	Content Expert	Provincial

Nicholas Myers	Physician	Primary Care Representatives	Calgary Zone
Rod Elford	Physician	Primary Care Representatives	Calgary Zone
Sophia Christoforakis	SCN Representative	Surveyor	Provincial

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For questions or feedback related to this knowledge topic please contact Clinical Knowledge Topics by emailing ClinicalKnowledgeTopics@albertahealthservices.ca