

NEIGHBORHOOD HEALTH PLAN OF RHODE ISLAND	
Section: Clinical Practice Guideline	Subject: Diagnosis and Management of Adult Coronary Artery Disease
Effective: December 1, 2009	Updated:

RATIONALE

Coronary artery disease (CAD) is the most common type of heart disease and is the leading cause of death in the United States for both men and women. For many patients, the first manifestation of CAD will be sudden death. A significant number of patients who experience an acute myocardial infarction will die within 24 hours of the onset of ischemia, and many of the survivors will suffer significant morbidity. Lifestyle changes, medicines, and/or medical procedures can effectively prevent or treat CAD in most people.

DEFINITION

Coronary Artery Disease (CAD) in this guideline includes adults with diagnosed CAD, either asymptomatic or symptomatic (angina pectoris) and those with acute coronary syndrome (ACS). Patients with an acute coronary syndrome include those whose clinical presentations cover the following range of diagnoses: unstable angina (UA), myocardial infarction (MI) with ST elevation (STEMI), and MI without ST elevation (NSTEMI).

TABLE OF CONTENTS

This guideline includes the following sections:

Section	Subsection
Section I: Prevention of CAD	Risk Factor Identification and Management
Section II: Diagnosis and Management of Chronic Stable Angina	Diagnosis and Risk Stratification Testing Recommendations Treatment Follow-up Asymptomatic Patients
Section III: Management of Patients with Acute Coronary Syndrome	Definition of ACS Management of Patients at risk for ACS Symptoms of ACS Prehospital Management of Possible ACS ED Triage ACS
Section IIIA: Management of Patients with ST-Segment Myocardial Infarction (STEMI)	Pre-hospital Management ED Evaluation Immediate Management Hospital Management Management of Complications of STEMI Convalescence, Discharge and Post-MI Care
Section IIIB: Management of Patients with Unstable Angina (UA) and Non-ST-Segment Elevation Myocardial Infarction (NSTEMI)	Pre-Hospital Management ED Evaluation and Immediate Management Risk Stratification Early Hospital Care Risk Stratification before Discharge Coronary Revascularization Hospital Discharge and Post Hospital Care Management of Special Groups

RESOURCES

The following documents were used in preparing this guideline:

1. “ACC/AHA 2002 Guideline Update for the Management of Patients with Chronic Stable Angina”
2. “ACC/AHA Guideline for the Management of Patients with ST-Elevation Myocardial Infarction (STEMI)” 2004
3. “ACC/AHA 2007 Guideline for the Management of Patients with Unstable Angina/Non-ST-Elevation Myocardial Infarction (UA/NSTEMI)”
4. “Evaluation of Primary Care Patients with Chronic Stable Angina: Guidelines from the American College of Physicians” (National Guideline Clearinghouse)
5. “Diagnosis and Treatment of Chest Pain and ACS”; Institute for Clinical Systems Improvement; Oct. 2006

IMPLEMENTATION

SECTION I: PREVENTION OF CAD

RISK FACTOR IDENTIFICATION AND MANAGEMENT

The major risk factors for development of CAD are well established and clinical trials have demonstrated that modification of those risk factors can prevent the development of CAD (primary prevention) or reduce the risk of experiencing ACS in patients who have CAD (secondary prevention). Major risk factors and goals for intervention include:

Risk	Goal
Cigarette smoking of any amount	Complete cessation of smoking and no exposure to environmental tobacco smoke (B)
Elevated blood pressure	BP<140/90 (or 130/80 for patients with chronic kidney disease, diabetes or existing CAD) (A)
Adverse lipid profiles	LDL-C <100 mg/dL (A)
Overweight or obesity, especially abdominal obesity	BMI 18.5-24.9 Waist circumference men <40”, women <35”
Physical inactivity	Exercise for 30 minutes, 7 days per week (B)

Other factors that can predispose to risk for CAD include:

- Family history of early heart disease
- Advancing age

To identify/manage patients at risk for CAD and/or ACS, primary care providers (PCPs) should:

- evaluate the presence and status of control of major risk factors for CAD for all patients >20 years of age at regular intervals (every 3-5 years). (C)
- calculate 10 year risk of developing CAD (National Cholesterol Education Project/NCEP global risk assessment tool ¹) for all patients who have 2 or more major risk factors to assess the need/urgency for primary prevention strategies. (B) ²
- Identify patients with established CAD or CAD risk equivalent (diabetes mellitus, chronic kidney disease, or 10 year risk >20%) for secondary prevention by intensive risk factor intervention. (A) ³
- Begin primary prevention for any patient with a single elevated risk factor after assessment of specific risk level to guide selection and prioritization of interventions.
- Make any at-risk patient aware of the specific risk level to motivate lifestyle changes.
- Use aspirin prophylaxis in primary prevention for patients whose 10 year risk of CHD is $\geq 6\%$. Aspirin 75-162 mg/d as primary prophylaxis should be discussed with these patients.

SECTION II: DIAGNOSIS AND MANAGEMENT OF PATIENTS WITH CHRONIC STABLE ANGINA

Chronic stable angina is the initial manifestation of ischemic heart disease in about one half of patients. This section applies to adult patients with stable chest pain syndromes and known or suspected ischemic heart disease; it includes patients who have “ischemic equivalents” such as dyspnea on exertion or arm pain with exertion. It also includes the approach to a special group of asymptomatic patients with known or suspected coronary artery disease (CAD).

DIAGNOSIS and RISK STRATIFICATION

Definition of Angina

Angina is a clinical syndrome characterized by discomfort in the chest, jaw, shoulder, back or arm. It is typically aggravated by exertion or emotional stress and relieved by nitroglycerin. Angina usually occurs in patients with coronary artery disease (CAD) involving one or more large epicardial arteries but can also occur in patients with other cardiac problems. (*e.g.* valvular heart disease, hypertrophic cardiomyopathy, uncontrolled hypertension, myocardial ischemia related to spasm or endothelial dysfunction).

History

1. Chest Pain Characteristics

- **Location** – usually substernal but may radiate to neck, jaw, epigastrium or arms
- **Quality** – “squeezing”, “griplike”, “pressure”; not sharp or stabbing
- **Duration** – minutes in duration; usually not fleeting or dull ache lasting for hours.
- **Factors that provoke** – usually precipitated by exertion or stress; does not change with position or respiration
- **Factors that relieve** – rest, sublingual nitroglycerin.
- **Women** may have atypical symptoms of cardiac ischemia, *e.g.* fatigue, shortness of breath without chest pain, nausea and vomiting, back pain, jaw pain, dizziness, weakness.

2. Clinical Classification of Chest Pain – can be used, with age and gender, to predict probability of significant CAD

- Typical angina (definite) – has all of the above characteristics of anginal pain
- Atypical angina (probable) – meets two of the above characteristics
- Low cardiac risk (non-specific) chest pain – meets one or none of typical anginal characteristics

3. Risk factors for CAD – increase the probability of CAD

- Cigarette smoking
- Hyperlipidemia
- Diabetes
- Hypertension
- Family history of premature CAD
- Past history of cerebrovascular or peripheral vascular disease

4. Age (older > younger) and Gender (male > female) affect the probability of CAD

Physical Examination

- Often normal in patients with stable angina
- Exam during pain may be beneficial for cardiac signs predictive of CAD
- Look for evidence of other cardiac conditions associated with angina (*e.g.* valvular heart disease, cardiomyopathy)
- Evidence of noncoronary atherosclerotic disease increases likelihood of CAD
- Findings indicating presence of CAD risk factors increases likelihood of CAD
- Look for presence of noncardiac causes of chest pain or of comorbid conditions that may precipitate “functional” angina (myocardial ischemia in absence of significant CAD)

Laboratory

1. **Hemoglobin (C)** – severe anemia can precipitate angina
2. **Fasting glucose (C)** – to R/O diabetes
3. **Fasting lipid panel (C)** – screen for hyperlipidemias

4. **Rest ECG** (12 lead) in patients without an obvious non-cardiac cause of chest pain (B); patients with chronic stable angina who have rest ECG abnormalities are at greater risk for death or nonfatal MI than those with normal ECG.
5. **Rest ECG** during an episode of chest pain (B)
6. **Chest x-ray** in patients with signs or symptoms of
 - Heart failure (HF)
 - Valvular heart disease
 - Pericardial disease
 - Aortic dissection/aneurysm (B)
7. **Rest echocardiography or Radionuclide Imaging (RNA)** – only needed in assessment of patients with suspected chronic stable angina in the following circumstances:
 - Echocardiography in patients with systolic murmur suggestive of aortic stenosis, mitral regurgitation, and/or hypertrophic cardiomyopathy.(C)
 - Echocardiography or RNA to assess global LV systolic function in patients with
 - History of prior MI
 - Pathological Q waves
 - Symptoms or signs suggestive of HF or LV dysfunction
 - Complex ventricular arrhythmias (B)

Estimating Probability of Significant CAD

In patients presenting with chest pain, the probability of CAD should be estimated on the basis of

- patient age,
 - gender,
 - cardiovascular risk factors, and
 - pain characteristics. (B)
1. **Low probability of CAD**
 - If pain is felt to be noncardiac
 - focus history and appropriate tests on noncardiac causes of chest pain⁴
 - prescribe appropriate treatment and followup for the noncardiac condition
 - educate patient about CAD and risk factors, initiate primary prevention
 - A decision to pursue further testing (e.g. standard exercise test) should be based on a discussion between patient and clinician.
 2. **Intermediate or high probability** – patient should undergo diagnosis and risk stratification through further testing.
 3. **Comorbid conditions provoking or exacerbating myocardial ischemia** must be considered in all patients.⁵

TESTING RECOMMENDATIONS - INTERMEDIATE OR HIGH PROBABILITY OF CAD

1. **Exercise ECG without an imaging modality**
 - Initial test for diagnosis and risk stratification of obstructive CAD in patients with **intermediate probability** of CAD who are able to exercise and not taking digoxin, including those with complete right bundle-branch block (RBBB) or < 1 mm of ST depression at rest. (B)
 - **Not indicated** for patients with
 - abnormal baseline ECG (pre-excitation syndrome, electronically-paced ventricular rhythm, > 1 mm ST depression at rest, complete LBBB)
 - established CAD diagnosis (prior MI, prior coronary angiography)
 - severe comorbidity likely to limit life expectancy or prevent revascularization.

Women: the use of exercise testing in women presents difficulties reflecting the different prevalence of CAD in women and the sensitivity and specificity of exercise testing. However, ECG exercise testing remains the recommended initial test for evaluating women for CAD.

2. **Cardiac Stress Imaging** (Echocardiography or myocardial perfusion imaging)

Stress imaging is most helpful for routine diagnostic purposes in patients with an intermediate pretest probability of obstructive CAD, due to issues of test sensitivity and specificity in these patients. However, prognostic information from stressing high risk individuals may be helpful.

Exercise Modality

- **Exercise echocardiography or exercise myocardial perfusion imaging** as initial test for diagnosis and risk stratification for patients with intermediate probability of CAD who are able to exercise and have
 - pre-excitation (Wolff-Parkinson-White) syndrome
 - > 1 mm ST depression in baseline resting ECG, including those with LV hypertrophy or taking drugs such as digitalis (B)
 - prior history of revascularization (PCI or CABG) (B)

Pharmacologic Modality

- **Dipyridamole or adenosine myocardial perfusion imaging or dobutamine echocardiography** as initial test for risk stratification in patients with intermediate probability of CAD who
 - are unable to exercise
 - are unable to exercise and have history of prior revascularization (PCI or CABG) (B)
- **Dipyridamole or adenosine myocardial perfusion imaging** in patients
 - With LBBB or electronically-paced ventricular rhythm, regardless of patient's ability to exercise. (B/C)
- **Not indicated** for patients with severe comorbidity likely to limit life expectancy or prevent revascularization.

The selection of the type of pharmacological stress will depend on specific patient factors such as

- Heart rate and BP
- Presence or absence of bronchospastic disease
- Presence of LBBB or pacemaker
- Likelihood of ventricular arrhythmias.

3. Coronary Angiography

This invasive technique remains the most accurate for the diagnosis of clinically important obstructive CAD. It is recommended for

- Patients with disabling (Canadian Cardiovascular Society⁶ {CCS} classes III and IV) chronic stable angina despite medical therapy (B)
- Patients with high probability of CAD on clinical assessment and/or noninvasive testing regardless of anginal severity. (B)
- Patients who have survived sudden cardiac death or serious ventricular arrhythmia.(B)
- Patients with angina and symptoms and signs of heart failure. (C)

Summary of Recommendations for Testing:

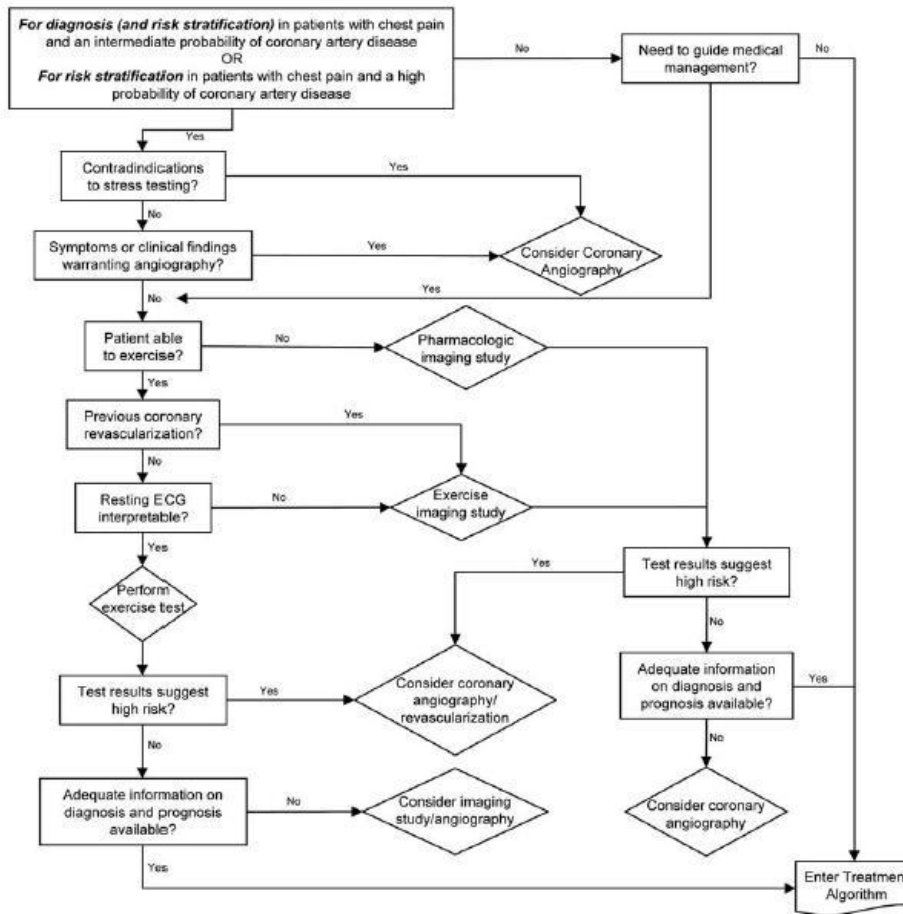


Figure 3. Stress testing/angiography. ECG indicates electrocardiogram.

TREATMENT

The treatment of chronic stable angina has two objectives:

- To reduce the risk of mortality and death and
- To reduce symptoms.

The goal of treatment for most patients should be complete, or nearly complete, elimination of anginal chest pain and return to normal activities and a functional capacity of CCS class I angina, accomplished with minimal side effects of therapy.

Basic Treatment/Education Mnemonic:

- A. Aspirin and Antianginal therapy
- B. Beta blockers and Blood pressure
- C. Cigarette smoking and Cholesterol
- D. Diet and Diabetes
- E. Education and Exercise

Pharmacologic Therapy to Prevent MI and Death and to Reduce Symptoms

- **Aspirin** 75-162 mg/day started and continued indefinitely in the absence of contraindications. (A)
- **Beta blockers** should be started and continued indefinitely in patients who have/have had
 - MI
 - Acute coronary syndrome
 - Left ventricular dysfunction with or without HF symptoms (A)

- **ACE inhibitors** should be started and continued indefinitely (unless contraindicated) in
 - Patients with left ventricular ejection fraction (LVEF) $\leq 40\%$ (A)
 - Patients with hypertension, diabetes, or chronic kidney disease (A)
 - Patients who are not lower risk (“lower risk” = normal LVEF, cardiovascular risk factors well-controlled, revascularization has been performed) (B).
- **Angiotensin receptor blockers (ARBs)** are recommended for patients who
 - Have hypertension
 - Have indications for but are intolerant of ACE inhibitors
 - Have heart failure
 - Have had an MI with LVEF $\leq 40\%$. (A)
- **Aldosterone blockade** recommended for use in post-MI patients without significant renal dysfunction or hyperkalemia who
 - Are already receiving therapeutic doses of an ACE inhibitor and a beta blocker
 - Have a LVEF $\leq 40\%$ **and**
 - Have either diabetes or HF. (A)
- **LDL-lowering therapy** in patients with LDL-C >100 mg/dL (target LDL of <100 mg/dL). (A)
- **Sublingual nitroglycerin or nitroglycerin spray** for immediate relief of angina. (B)
- **Calcium antagonists (calcium-channel blockers) and/or long-acting nitrates**
 - As initial therapy for reduction of symptoms when beta blockers are contraindicated(B)
 - In combination with beta-blockers when initial treatment with beta-blockers is not successful (B)
 - As substitute for beta-blockers if initial treatment with beta blockers leads to unacceptable side effects.
- **Influenza vaccine** recommended for patients with CAD. (B)

Therapy to Reduce Risk Factors

- **Smoking** – smoking cessation⁷ and avoidance of exposure to environmental tobacco smoke at work and home.
- **BP control**
 - Goal: BP $<140/90$ mm Hg (or $<130/80$ for patients with diabetes or chronic kidney disease) (A)
 - Patients should initiate and/or maintain lifestyle modifications – weight control, increased physical activity, moderation of alcohol consumption, limited sodium intake, maintenance of healthy diet (B)
 - Add BP medication as tolerated for patients with well-established CAD, treating initially with beta blockers and/or ACE inhibitors. (C)
- **Lipid management**
 - Assessment of fasting lipid profile (A)
 - Goal: LDL-C < 100 mg/dL (A)
 - Diet with reduced intake of saturated fats ($< 7\%$ total calories), trans-fatty acids, and cholesterol (<200 mg./day) (B)
 - Daily physical activity and weight management for all patients (B)
 - LDL-lowering drug therapy if baseline LDL-C ≥ 100 mg/dL (A)
 - Intensification of LDL-lowering therapy if LDL-C ≥ 100 mg/dL on treatment (A)
 - If triglycerides (TG) are 200-499 mg/dL, non-HDL-C should be < 130 mg/dL (B)
 - If TG ≥ 500 mg/dL, initiate fibrate or niacin to lower TG to reduce risk of pancreatitis before initiating LDL-lowering therapy. (C)
 - Drug combinations are beneficial for patients on lipid lowering therapy who are unable to achieve LDL-C <100 mg/dL. (C)
- **Physical Activity**
 - 30-60 minutes, 7 days/week (minimum 5 days/week) (B)
 - Assess patient’s risk with physical activity history; Where appropriate, an exercise test is useful to guide the exercise prescription (B)

- Medically supervised programs (cardiac rehabilitation) are recommended for at-risk patients (e.g. recent ACS or revascularization, HF) (B)
- **Weight Management**
 - Assess BMI and waist circumference regularly. Encourage weight maintenance/reduction when indicated to achieve and maintain BMI 18.5-24.9 (B)
 - Initial goal of weight loss therapy should be gradual reduction of body weight by ~10% from baseline. (B)
 - If waist circumference \geq 35 in. (women) or 40 in. (men), initiate lifestyle changes and consider treatment for metabolic syndrome as indicated. (B)
- **Diabetes Management**
 - Lifestyle and pharmacotherapy measures to achieve near-normal HbA1c. (B)
 - Vigorous modification of other risk factors as recommended should be initiated and maintained. (B)

Revascularization

- **Coronary Artery Bypass Graft (CABG)** recommended for
 - Patients with significant left main coronary disease. (A)
 - Patients with 3-vessel disease. The survival benefit is greater in patients with LVEF $<$ 50%. (A)
 - Patients with 2-vessel disease with significant proximal left anterior descending (LAD) CAD and either LVEF $<$ 50% or demonstrable ischemia on noninvasive testing. (A)
 - Patients with 1- or 2-vessel CAD without significant proximal LAD-CAD who have survived sudden cardiac death or sustained ventricular tachycardia. (C)
- **Percutaneous Coronary Intervention (PCI)** recommended for
 - Patients with 2- or 3-vessel disease with significant proximal left anterior descending CAD who have anatomy suitable for catheter-based therapy, normal LVEF and who do not have treated diabetes. (B)
- **PCI or CABG** recommended for
 - Patients with 1- or 2-vessel CAD without significant proximal left anterior descending CAD with a large area of viable myocardium and high-risk criteria on noninvasive testing. (B)
 - Patients with prior PCI who have recurrent stenosis associated with a large area of viable myocardium and/or high-risk criteria on noninvasive testing. (C)
 - Patients who have not been successfully treated by medical therapy and can undergo revascularization with acceptable risk. (B)

FOLLOW-UP (C)

Patient with successfully treated chronic stable angina should have follow-up evaluation every 4-12 months (every 4-6 months during first year, then annually or more often as needed for individual patient).

History – 5 questions must be answered at follow-up visits:

- Has patient decreased his/her level of physical activity?
- Have patient's anginal symptoms increased in frequency/severity?
- How well is patient tolerating pharmacologic therapy?
- How successful has patient been in risk factor reduction and improving knowledge about ischemic heart disease?
- Has patient developed any new comorbid illnesses or has severity or treatment of known comorbid illnesses worsened patient's angina?

Physical Examination

- Weight, BP, pulse (note jugular venous pressure/wave form, carotid pulse magnitude, carotid bruits if present)
- Pulmonary – note rales, rhonchi, wheezing, decreased breath sounds
- Cardiac – presence of gallops, new or changed murmur, location of apical impulse
- Vascular – any change in peripheral pulses and new bruits

- Abdominal – identify hepatomegaly, hepatojugular reflux, pulsatile masses suggestive of abdominal aortic aneurysm.
- Extremities – presence or absence of peripheral edema.

Laboratory

- FBS every 3 years; annual HbA1c for persons with diabetes.
- Lipid profile and liver function testing 6-8 weeks after starting lipid-lowering drug therapy, then lipid profile at 4-6 month intervals.
- Other lab tests as required by patient's history, physical exam, or clinical course.

Testing

- **Chest x-ray** for patients with new or worsening CHF.
- **Treadmill exercise test/ECG** for patients
 - without prior revascularization
 - who have significant change in clinical status
 - are able to exercise and
 - do not have specified ECG abnormalities (i.e. pre-excitation [WPW] syndrome, electronically paced ventricular rhythm, > 1 mm or rest ST depression, complete LBBB).
- **Echocardiography or stress radionuclide imaging procedures** for
 - Patients with new or worsening CHF or evidence of intervening MI, to assess LVEF and segmental wall motion
 - Patients without prior revascularization who have significant change in clinical status and are unable to exercise or have one of ECG abnormalities noted above.
 - Patients who have a significant change in clinical status and required a stress imaging procedure on initial evaluation.
 - Patients with prior revascularization who have a significant change in clinical status.
- **Coronary angiography** in patients with marked limitation of ordinary activity (CCS class III) despite maximal medical therapy.

ASYMPTOMATIC PATIENTS

The ACC/AHA recommends against “screening” asymptomatic outpatients for coronary artery disease. However, patients may present after such tests have been performed and have “abnormal” results. The following recommendations apply to such patients:

Testing

- **Exercise ECG** – asymptomatic patients who are able to exercise can usually be evaluated in this way. Recommendations for risk stratification would be the same as for symptomatic patients. (C)
- **Stress Imaging Studies** – indications for use in asymptomatic patients are the same as for symptomatic patients, based on whether patient is able to exercise or whether abnormalities on resting ECG are present, *i.e.*
 - Exercise myocardial perfusion imaging or exercise echocardiography for patients with intermediate-or-high-risk score on exercise ECG; (C)
 - Adenosine or dipyridamole myocardial perfusion imaging or dobutamine echocardiography in patients with a previously inadequate exercise ECG; (C)
 - **Not indicated** for asymptomatic patients with low-risk score on exercise ECG. (C)
- **Coronary Angiography** – indicated only for patients with high-risk criteria suggesting ischemia on noninvasive testing. (C)

Treatment

- **Pharmacologic**
 - Aspirin in the absence of contraindications in patients with prior MI.
 - Beta blockers as initial therapy in the absence of contraindications in patients with prior MI.
 - LDL-lowering therapy in patients with documented CAD and LDL-C >130 mg/dL, with a target LDL of <100 mg/dL

- ACE inhibitor in patients with documented CAD who also have diabetes and/or systolic dysfunction.
- **Risk factor reduction**
 - **Secondary prevention measures** as outlined above for patients with documented CAD on noninvasive testing or coronary angiography.
 - **Primary prevention measures** as discussed in Section I of this guideline in the absence of documented CAD.
- **Revascularization**
 - Recommendations for PCI or CABG are the same as those for symptomatic patients.

SECTION III: MANAGEMENT OF PATIENTS WITH ACUTE CORONARY SYNDROME (ACS)

DEFINITION

“Acute coronary syndrome” (ACS) refers to any constellation of clinical symptoms that are compatible with acute myocardial ischemia; this includes patients with unstable angina (UA) or myocardial infarction (MI), either ST-segment elevation myocardial infarction (STEMI) or non-ST-segment elevation myocardial infarction (NSTEMI). The most urgent priority of early evaluation of patients with “possible ACS” is

- to identify patients with STEMI who should be considered for immediate reperfusion therapy and
- to recognize other potentially catastrophic causes of patient symptoms, such as aortic dissection.

MANAGEMENT OF PATIENTS AT RISK FOR ACS

1. Providers should target for education⁸ those patients at increased risk for ACS, *i.e.* patients with
 - known CAD,
 - peripheral vascular disease,
 - cerebral vascular disease, diabetes, or
 - 10 year Framingham risk of CAD of >20 %
2. Health care providers should actively address the following issues regarding ACS with patients and their families:
 - The patient's heart attack risk (C)
 - How to recognize symptoms of ACS (C)
 - The advisability of calling 9-1-1 if symptoms are unimproved or worsening after 5 minutes, despite feelings of uncertainty about the symptoms and fear of potential embarrassment (C)
 - A plan for appropriate recognition and response to a potential acute cardiac event that includes the phone number to access emergency medical services (EMS), generally 9-1-1. (C)
3. Family members of patients at risk for ACS should:
 - be advised to take CPR training
 - familiarize themselves with the use of an automated external defibrillator (AED).
 - be referred to a CPR training program that has a social support component for family members of post-MI patients. (B)
4. Providers should remember that as many as 50% of MIs may be clinically silent (presenting with symptoms other than chest discomfort), especially in women, diabetics, older patients, and those with a history of heart failure.
5. All public safety first responders who respond to patients with chest pain and/or suspected cardiac arrest should be trained and equipped to provide early defibrillation with AEDs.

SYMPTOMS OF ACS

Patients with symptoms that may represent ACS should not be evaluated solely over the telephone but should be referred to a facility that allows evaluation by a physician and the recording of a 12-lead ECG and biomarker determination. (C) Symptoms that suggest ACS include:

- Chest discomfort with/without radiation to arm(s), back, neck, jaw or epigastrium
- Shortness of breath/dyspnea

- Weakness
- Diaphoresis
- Nausea/vomiting
- lightheadedness

Patients with symptoms of ACS should be transported to the hospital by ambulance rather than by friends or relatives. (B)

PRE-HOSPITAL MANAGEMENT OF PATIENTS WITH “POSSIBLE/SUSPECTED ACS”

1. Aspirin

- prehospital EMS providers should administer 162 to 325 mg of aspirin (chewed) to chest pain patients suspected of having ACS unless contraindicated or already taken by patient;
- more rapid buccal absorption occurs with non-enteric-coated formulations. (C)

2. Nitroglycerin (NTG): If NTG has been prescribed previously, health care providers should instruct patients to take no more than 1 NTG dose in response to chest discomfort/pain.

- If chest pain unimproved or worsening 5 min. after 1 NTG, call 911 to access EMS.
- If symptoms are significantly improved by 1 NTG in patient with known chronic stable angina, instruct patient to repeat NTG every 5 min. for a maximum of 3 doses and call 911 if symptoms have not resolved completely. (C)

3. Patients with chest discomfort or other ischemic symptoms at rest for > 20 min., hemodynamic instability, or recent syncope/presyncope should be referred immediately to the ED. (C)

4. Patients who are experiencing less severe symptoms with none of above high-risk features, including those who respond to NTG dose, may be seen initially in an ED or in an outpatient facility able to provide an acute evaluation. (C)

EMERGENCY DEPARTMENT (ED) TRIAGE FOR PATIENTS WITH POSSIBLE ACS

1. Assessment: patients with symptoms of ACS should be

- Sent by registration/clerical staff for immediate assessment by triage nurse
- Assessed immediately by triage nurse with stat 12-lead ECG obtained and definitively interpreted within 10 min. of arrival in ED if symptoms suggest ACS.
- Triage nurse should take a brief, targeted history including
 - History of CABG, PCI, CAD, angina on effort, or MI
 - NTG use to relieve chest discomfort
 - Risk factors, including smoking, hyperlipidemia, hypertension, diabetes, family history, cocaine or methamphetamine use
 - Regular and recent medication use.

Above assessment must not delay entry into the ACS protocol.

2. ECG: if initial ECG not diagnostic but patient remains symptomatic with high clinical suspicion for ACS, serial ECGs at 15-30 min. intervals (or continuous 12-lead ECG monitoring) should be performed to detect potential for development of ST-segment elevation or depression. (B)

3. Cardiac biomarkers: patient should have measurement of cardiac biomarkers; cardiac-specific troponin is preferred. Patients with negative biomarkers 6 h after symptom onset should have biomarkers remeasured 8-12 h after symptom onset. (B)

4. Risk Stratification: patients with possible ACS should undergo early risk stratification for risk of cardiovascular events (e.g. death or MI) that focuses on history, anginal symptoms, physical findings, ECG findings, and biomarkers of cardiac injury, after which the patient should be assigned to 1 or 4 categories:

- a noncardiac diagnosis,
- chronic stable angina,
- possible ACS,
- definite ACS. (C)

5. Diagnosis and Management:

- **Non-cardiac diagnosis:** testing/treatment as indicated by alternative diagnosis; management of these patients is outside the scope of these guidelines.
- **Chronic stable angina:** manage per guidelines in Section II (above)
- **Possible ACS** (recent episode of chest discomfort at rest but pain-free when evaluated, normal or unchanged ECG, no elevations of cardiac biomarkers): observe in ED or chest pain unit
- **Definite ACS** (episode of typical ischemic discomfort-new onset, severe, accelerating pattern) **identified with ST-elevation MI (STEMI)** on ECG: evaluate for immediate reperfusion therapy and manage according to guidelines in Section IIIA (below).
- **Definite ACS identified with non-ST-elevation MI (NSTEMI) or unstable angina (UA):** manage according to guidelines in Section IIIB (below).

SECTION IIIA: MANAGEMENT OF PATIENTS WITH ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION (STEMI)

PRE-HOSPITAL MANAGEMENT

1. **Management:** see guidelines above for patients with possible ACS.
2. **Destination:**
 - Patients with suspected or confirmed STEMI who have cardiogenic shock and are less than 75 years of age should be brought immediately or secondarily transferred to facilities capable of cardiac catheterization and rapid revascularization (percutaneous coronary intervention [PCI] or coronary artery bypass graft surgery [CABG]) if it can be performed within 18 hours of onset of shock. (A)
 - Patients with suspected or confirmed STEMI who have contraindications to fibrinolytic therapy should be brought immediately or secondarily transferred promptly (*i.e.* primary receiving hospital door-to-departure time less than 30 minutes) to facilities capable of cardiac catheterization and rapid revascularization (PCI or CABG). (B)
 - Every community should have a written protocol that guides EMS system personnel in determining where to take patients with suspected or confirmed STEMI. (C)

EMERGENCY DEPARTMENT (ED) EVALUATION

Rapid evaluation in the ED is required to provide the appropriate effective, time-dependent treatment for STEMI. The delay from patient contact with the health care system (typically, arrival at the ED or contact with paramedics) to

- **initiation of fibrinolytic therapy should be less than 30 minutes.**
 - **percutaneous coronary intervention (PCI) should be less than 90 minutes.** (B)
1. **Choice of initial STEMI treatment** should be made by the emergency medicine physician on duty based on a predetermined, institution-specific, written protocol that is a collaborative effort of cardiologists (both those involved in coronary care unit management and interventionalists), emergency physicians, primary care physicians, nurses, and other appropriate personnel. (C)
 2. If the initial diagnosis and treatment plan is unclear to the emergency physician or is not covered directly by the agreed-on protocol, immediate cardiology consultation is advisable. (C)
 3. **Targeted patient history** should include:
 - prior episodes of myocardial ischemia such as stable or unstable angina, MI, CABG, or PCI.
 - evaluation of the patient's complaints focusing on
 - chest discomfort (severity scale of 1-10),
 - associated symptoms (nausea/vomiting, diaphoresis, weakness or profound fatigue, dizziness and/or syncope, paresthesias),
 - sex- and age-related differences in presentation,
 - hypertension,
 - diabetes mellitus,
 - possibility of aortic dissection,
 - risk of bleeding, and

- clinical cerebrovascular disease (amaurosis fugax, face/limb weakness or clumsiness, face/limb numbness or sensory loss, ataxia, or vertigo). (C)
4. **Brief physical exam** to aid in diagnosis and assessment of the extent, location and presence of complications of STEMI should include:
 - airway, breathing, circulation (ABC)
 - vital signs, general observation
 - presence/absence of jugular venous distension
 - pulmonary auscultation for rales
 - cardiac auscultation for murmurs and gallops
 - presence or absence of pulses
 - presence or absence of systemic hypoperfusion
 - focused, limited neurological exam for evidence of prior stroke or cognitive deficits (possible contraindication for fibrinolytic therapy)
 5. **12 lead Electrocardiogram (ECG)**
 - All patients should be monitored electrocardiographically on arrival in ED because lethal ventricular arrhythmias may develop abruptly in patients with STEMI.
 - If initial 12 lead ECG not diagnostic of STEMI but patient remains symptomatic with high clinical suspicion for STEMI, begin continuous 12-lead ST-segment monitoring or perform serial 12 lead ECGs at 5-10 min. intervals to detect development of ST elevation. (C)
 6. **Laboratory examinations** should be performed but should not delay implementation of reperfusion therapy (C):
 - Serum biomarkers for cardiac damage (creatinine kinase/CK-MB; cardiac-specific troponins [cTnI, cTnT]; myoglobin); use cardiac-specific troponins in patients with coexistent skeletal muscle injury
 - CBC with platelet count
 - INR (international normalized ratio)
 - aPTT (activated partial thromboplastin time)
 - Electrolytes and magnesium
 - BUN/creatinine
 - Glucose
 - Serum lipids
 7. Recommended **imaging** includes:
 - Portable chest x-ray (but this should not delay implementation of reperfusion therapy) (C)
 - High-quality portable chest X-ray, transthoracic and/or transesophageal echocardiography, and a contrast chest computed tomographic scan or a magnetic resonance imaging (MRI) scan should be used to differentiate STEMI from aortic dissection in patients for whom this distinction is initially unclear. (B)

IMMEDIATE MANAGEMENT

Routine Measures

1. Supplemental **oxygen** should be administered to patients with arterial oxygen desaturation ($SaO_2 < 90\%$) (B); limit routine use of oxygen to the first 6 hours.
2. **Nitroglycerin**
 - Patients with ongoing ischemic discomfort should receive **sublingual nitroglycerin (0.4 mg)** every 5 minutes for a total of 3 doses, after which an assessment should be made about the need for intravenous nitroglycerin. (C)
 - **Intravenous nitroglycerin** is indicated for relief of ongoing ischemic discomfort, control of hypertension, or management of pulmonary congestion. (C)
 - **Nitrates should not be administered**
 - To patients with systolic BP < 90 mm Hg, BP ≥ 30 mm Hg below baseline, severe bradycardia (< 50 beats per minute), tachycardia (> 100 beats per minute), or suspected RV infarction (C)

- To patients who have received a phosphodiesterase inhibitor for erectile dysfunction within 24 hours (B)
- To patients whose hypotension might limit the administration of beta-blockers.

3. Analgesia

- **Morphine sulfate** (2-4 mg intravenously [IV] with increments of 2-8 mg IV repeated at 5- to 15-minute intervals) for management of pain associated with STEMI. (C)
 - Nonsteroidal anti-inflammatory drugs (NSAIDs) (except for aspirin) should be discontinued at the time of presentation with STEMI (C)
4. **Aspirin** should be chewed by patients who have not taken aspirin before presentation with STEMI; initial dose 162 mg. (A) to 325 mg. (C).
5. **Oral beta-blocker therapy** should be administered promptly to those patients without a contraindication, irrespective of concomitant fibrinolytic therapy or performance of primary PCI. (A).

Reperfusion

All STEMI patients should undergo rapid evaluation for reperfusion therapy. All appropriate patients with suspected STEMI should have a reperfusion strategy implemented promptly after contact with the medical system. (A) **The appropriate and timely use of some reperfusion therapy may be more important than the choice of therapy.**

1. Selection of reperfusion strategy: Assess Time and Risk

- For up to 3 hours, PCI is considered the treatment of choice and maybe used after that time, according to clinical situation. (B) Fibrinolytic therapy may be used when PCI is not available and symptom duration is less than 3 hours (B)
- Risk of mortality for particular patient with STEMI
- Risks of fibrinolysis
 - **contraindications** to fibrinolytic therapy include (A)
 - any history of intracranial hemorrhage (ICH),
 - significant closed head or facial trauma within the past 3 months,
 - uncontrolled hypertension,
 - ischemic stroke within the past 3 months.
 - STEMI patients at substantial (greater than or equal to 4%) risk of ICH should be treated with PCI rather than with fibrinolytic therapy. (A)
- Time required for transport to a skilled PCI laboratory ⁹

Fibrinolysis is generally preferred if:	An Invasive Strategy is generally preferred if:
<ul style="list-style-type: none"> ● Early presentation (≤ 3 hrs from onset of symptoms and delay to invasive strategy) ● Invasive strategy is not an option ● Delay to invasive strategy 	<ul style="list-style-type: none"> ● Skilled PCI lab available with surgical backup ● High risk from STEMI (cardiogenic shock, Killip class ≥ 3) ● Contraindications to fibrinolysis ● Late presentation (> 3 hours) ● Diagnosis of STEMI is in doubt

2. PCI

STEMI patients presenting to a hospital with PCI capability should be treated with primary PCI within 90 minutes of first medical contact. (A) **PCI is suitable for at least 90% of patients presenting with suspected STEMI.**

Coronary Angiography - diagnostic coronary angiography should be performed in:

- candidates for primary or rescue PCI. (A)
- patients with cardiogenic shock who are candidates for revascularization. (A)
- candidates for surgical repair of ventricular septal rupture or severe mitral regurgitation (MR). (B)
- patients with persistent hemodynamic and/or electrical instability. (C)

Primary PCI should be performed

- in patients with STEMI (including true posterior MI) or MI with new or presumably new LBBB who can undergo PCI of the infarct artery within 12 hours of symptom onset, if performed in a timely fashion in a skilled PCI laboratory ¹⁰(A)
- within 90 minutes of first medical contact (A)

Rescue PCI should be performed

- for patients < 75 years old with ST elevation or LBBB who develop shock within 36 hours of MI and are suitable for revascularization that can be performed within 18 hours of shock, unless further support is futile because of the patient's wishes or contraindications/unsuitability for further invasive care. (A)
- in patients with severe CHF and/or pulmonary edema (Killip class 3) and onset of symptoms within 12 hours. (B)

3. Fibrinolysis

STEMI patients presenting to a hospital **without** PCI capability and who cannot be transferred to a PCI center and undergo PCI within 90 minutes of first medical contact should be treated with fibrinolytic therapy within 30 minutes of hospital presentation unless fibrinolytic therapy is contraindicated. (B)

Acute Surgical Reperfusion (Coronary Artery Bypass Graft/CABG)

Emergency CABG should be undertaken in the following circumstances:

- Failed PCI with persistent pain or hemodynamic instability in patients with coronary anatomy suitable for surgery. (B)
- Persistent or recurrent ischemia refractory to medical therapy in patients who have coronary anatomy suitable for surgery, have a significant area of myocardium at risk, and are not candidates for PCI or fibrinolytic therapy. (B)
- At the time of surgical repair of postinfarction ventricular septal rupture (VSR) or mitral valve insufficiency. (B)
- Cardiogenic shock in patients < 75 years old with ST elevation, LBBB, or posterior MI who develop shock within 36 hours of STEMI, have severe multivessel or left main disease, and are suitable for revascularization that can be performed within 18 hours of shock, unless further support is futile because of the patient's wishes or contraindications/unsuitability for further invasive care. (A)
- Life-threatening ventricular arrhythmias in the presence of $\geq 50\%$ left main stenosis and/or triple-vessel disease. (B)

Ancillary Measures

1. **Antithrombins: Unfractionated heparin (UFH)** should be given intravenously to:

- Patients undergoing percutaneous (PCI) or surgical CABG) revascularization (C)
- patients undergoing reperfusion therapy with fibrin-specific fibrinolytic agents (C)
- patients treated with nonselective fibrinolytic agents (streptokinase, anistreplase, or urokinase) who are at high risk for systemic emboli (B)

Platelet counts should be monitored daily in patients given UFH. (C)

2. **Antiplatelets:**

- **Aspirin:** a daily dose of aspirin (initial dose 162-325 mg; maintenance dose 75-162 mg. qd) should be given indefinitely after STEMI to all patients without a true aspirin allergy. (A)
- **Thienopyridines (clopidogrel)** should be:
 - started in patients who have undergone diagnostic cardiac catheterization and for whom PCI is planned, (B)
 - added (75 mg po qd) to aspirin and continued for 14 days in patients with STEMI treated with fibrinolytic therapy or not receiving reperfusion therapy. (A)

In patients taking clopidogrel in whom CABG is planned, the drug should be withheld for at least 5-7 days unless the urgency for revascularization outweighs the risks of excess bleeding. (B)

3. Inhibition of Renin-Angiotensin-Aldosterone System

- An **angiotensin-converting enzyme (ACE) inhibitor** should be administered orally within the first 24 hours of STEMI in the absence of hypotension (systolic blood pressure < 100 mm Hg or < 30 mm Hg below baseline) or known contraindications to that class of medications. to patients with
 - anterior infarction,
 - pulmonary congestion, or
 - LVEF less than 0.40 (A)
- An **angiotensin receptor blocker (ARB)** should be administered to STEMI patients who are intolerant of ACE inhibitors and who have either clinical or radiological signs of heart failure or LVEF less than 0.40. (C)

4. **Strict Glucose control:** An insulin infusion to normalize blood glucose is recommended for patients with STEMI and complicated courses. (B)

HOSPITAL MANAGEMENT

Location

1. Coronary Care Unit (CCU)

- continuous monitoring of the ECG and pulse oximetry (C)
- ready access to facilities for hemodynamic monitoring and defibrillation. (C)
- review of medication regimen to confirm the administration of aspirin and beta-blockers and to assess the need for intravenous nitroglycerin (A)
- assessment of need for supplemental oxygen by monitoring arterial oxygen saturation (*i.e.*, O₂ saturation of less than 90%). When stable for 6 hours, the patient should be reassessed and discontinuation of supplemental oxygen should be considered. (C)
- placement of electrocardiographic monitoring leads based on the location and rhythm to optimize detection of ST deviation, axis shift, conduction defects, and dysrhythmias. (B)

2. Step-down unit

- low-risk STEMI patients who have undergone successful PCI can be admitted directly to the stepdown unit for post-PCI care rather than to the CCU. (C)
- STEMI patients originally admitted to the CCU who demonstrate 12 to 24 hours of clinical stability (absence of recurrent ischemia, heart failure, or hemodynamically compromising dysrhythmias) should be transferred to the stepdown unit. (C)

Level of Activity

1. A short period of bedrest followed by low-level activities such as toileting, assisted bathing, and light ambulation can prevent physiological deconditioning
2. Patients with STEMI who are free of recurrent ischemic discomfort, symptoms of heart failure, or serious disturbances of heart rhythm should not be on bed rest for more than 12 to 24 hours. (C)

Diet

1. NCEP Adult Treatment Panel III (ATP III) Therapeutic Lifestyle Changes (TLC) diet, which focuses on reduced intake of fats and cholesterol (C)
2. Diabetic patients with STEMI should have an appropriate food group balance and caloric intake. (B)
3. Sodium intake should be restricted in STEMI patients with hypertension or heart failure. (B)

Patient Education

1. Emphasize post-STEMI treatments for secondary prevention (e.g., compliance with taking medication, exercise prescription, and smoking cessation) (C)
2. Use critical pathways and protocols and other quality improvement tools (e.g., the American College of Cardiology (ACC) "Guidelines Applied in Practice" and the American Heart Association's (AHA's) "Get with the Guidelines") to improve the application of evidence-based treatments by patients with STEMI, caregivers, and institutions. (C)

Risk Stratification is a continuous process and requires the updating of initial assessments with data obtained during the hospital stay.

1. **Indicators of failed reperfusion** (e.g., recurrence of chest pain and persistence of ECG findings indicating infarction) identify a patient who should undergo coronary angiography.
2. Findings consistent with **mechanical complications** (e.g., sudden onset of heart failure or presence of a new murmur) herald increased risk and suggest the need for rapid intervention.
3. **Changes in clinical status** (e.g., development of shock) for patients who did not undergo primary reperfusion may herald a worsening clinical status and are an indication for coronary angiography.
4. Patients with a low risk of complications may be candidates for early discharge.
5. The lowest-risk patients are those who did not have STEMI despite the initial suspicions. Clinicians should strive to identify such patients within 8 to 12 hours of onset of symptoms.

Medication assessment

1. Beta-blockers

- Patients receiving beta-blockers within the first 24 hours of STEMI without adverse effects should continue to receive them during the early convalescent phase of STEMI. (A)
- Patients without contraindications to beta-blockers who did not receive them within the first 24 hours after STEMI should have them started in the early convalescent phase. (A)
- Patients with early contraindications within the first 24 hours of STEMI should be reevaluated for candidacy for beta-blocker therapy. (C)

2. Nitroglycerin

- **Intravenous nitroglycerin** is indicated in the first 48 hours after STEMI for treatment of
 - persistent ischemia,
 - Heart failure (HF), or
 - Hypertension.The decision to administer intravenous nitroglycerin and the dose used should not preclude therapy with other proven mortality reducing interventions, such as beta-blockers or ACE inhibitors. (B)
- **Intravenous, oral, or topical nitrates** are useful beyond the first 48 hours after STEMI for treatment of recurrent angina or persistent CHF if their use does not preclude therapy with beta-blockers or ACE inhibitors. (B)
- **Nitrates should not be administered** to patients with
 - systolic pressure less than 90 mm Hg or greater than or equal to 30 mm Hg below baseline,
 - severe bradycardia (less than 50 bpm),
 - tachycardia (more than 100 bpm), or
 - RV infarction. (C)

3. Inhibition of Renin-Angiotensin-Aldosterone System

- An **ACE inhibitor** should be administered orally during convalescence from STEMI in patients who tolerate this class of medication, and whose LVEF is less than 40%. It should be continued over the long term. (A)
- An **Angiotensin Receptor Blocker (ARB)** should be administered to STEMI patients who are intolerant of ACE inhibitors and have either clinical or radiological signs of heart failure or LVEF less than 40%. (B)
- Long-term **aldosterone blockade** should be prescribed for post-STEMI patients without significant renal dysfunction (creatinine ≤ 2.5 mg/dL in men and ≤ 2.0 mg/dL in women) or hyperkalemia (potassium ≤ 5.0 mEq/L) who
 - are already receiving therapeutic doses of an ACE inhibitor,
 - have an LVEF less than or equal to 0.40, and
 - have either symptomatic HF or diabetes. (A)

4. Antiplatelet medications

- **Aspirin** 162 - 325 mg should be given on day 1 of STEMI and in the absence of contraindications should be continued indefinitely on a daily basis thereafter at a dose of 75 -162 mg. (A)
- A **thienopyridine (clopidogrel)** should be administered to patients who are unable to take aspirin because of hypersensitivity or major gastrointestinal intolerance. (C)

- For patients who have undergone diagnostic cardiac catheterization and for whom PCI is planned, **clopidogrel** should be started and continued for
 - at least 1 month after bare metal stent implantation
 - for 12 months after drug-eluting stent implantation and
 - up to 12 months in patients who are not at high risk for bleeding. (B)

5. Oxygen

- Supplemental oxygen therapy should be continued beyond the first 6 hours only in STEMI patients with arterial oxygen desaturation (SaO₂ less than 90%) or overt pulmonary congestion. (C)

Estimation of Infarct Size

This is an important element in the overall care of patients with STEMI and can be done using one or more of 5 major modalities:

1. Electrocardiography – follow-up ECGs should be done at 24 hours and at discharge (B)
2. Cardiac biomarkers – serial creatine kinase (CK) and CK-MB isoenzyme.
3. Radionuclide imaging¹¹
4. Echocardiography¹²
5. Magnetic resonance imaging – a promising new technique not yet fully evaluated.

MANAGEMENT OF COMPLICATIONS OF STEMI

Hemodynamic Complications

1. **Hypotension** (systolic BP <90 mm Hg or 30 points below previous pressure) can result from hypovolemia, arrhythmias, RV or LV failure, mechanical complications of MI, or superimposed complications such as sepsis or pulmonary embolism. Management should include
 - Rapid volume loading with IV infusion if no evidence of volume overload (C)
 - Consider pulmonary artery catheter monitoring for progressive hypotension unresponsive to fluid administration
 - Intra-arterial monitoring if hypotension severe (systolic pressure <80). (C)
 - Correction of rhythm disturbances or conduction abnormalities, if present (C)
 - Consider Intra-aortic balloon counterpulsation if no response to other interventions (B)
 - Vasopressor support if hypotension not resolved after volume loading (C)
 - Echocardiography to evaluate mechanical complications, unless assessed by invasive measures (C)
2. **Low-output State** – should be aggressively diagnosed and treated like cardiogenic shock (see #4 below).
3. **Pulmonary Congestion/Pulmonary Edema** management should include
 - Diuretics
 - Echocardiography performed urgently to evaluate LV and RV function and to exclude a mechanical complication (C)
 - Oxygen supplementation to arterial saturation > 90% (C)
 - **If BP elevated as expected in presence of pulmonary edema**, then give
 - Oral ACE inhibitors (A)
 - Agents to reduce preload (nitrates, morphine sulfate, diuretics)
 - **If no elevation of systemic BP is present, suspect impending cardiogenic shock**
4. **Cardiogenic Shock is diagnosed when pulmonary edema is associated with hypotension.** Management and treatment should include
 - Echocardiography to evaluate possible mechanical complications unless already evaluated by invasive measures (C)
 - Consider Intra-arterial monitoring
 - Inotropic support (B)
 - Intra-aortic balloon counterpulsation (IABP) if shock not quickly reversed with pharmacological therapy prior to angiography and prompt revascularization (B)

- Mechanical reperfusion with PCI or CABG if <75 years old, within 36 hours of MI and suitable for revascularization that can be performed within 18 hours of shock. (A)
- Surgical correction of mechanical complications, if present, at time of revascularization. (B)

5. Right Ventricular Infarction

Patients with inferior STEMI and hemodynamic compromise should be screened for RV infarction with

- a right precordial V4R lead to detect ST-segment elevation and
- echocardiogram. (B)

RV ischemia/infarction treatment includes

- early maintenance of RV preload (C)
- reduction of RV afterload (C)
- inotropic support of the dysfunctional RV if not responsive to volume challenge (C)
- early reperfusion if possible (C)
- achievement and maintenance of AV synchrony and correction of bradycardia. (C)

Mechanical Complications

Mechanical causes of heart failure/low-output syndrome following STEMI should be considered when a new cardiac murmur is found on physical examination. Pulmonary artery catheter monitoring should be performed when mechanical complication is suspected and echocardiogram has not been performed. (C) A precise diagnosis can usually be established with transthoracic or transesophageal echocardiography.

1. Mitral Valve Regurgitation (MR)

- Patients with acute papillary muscle rupture/MR should be considered for urgent cardiac surgical repair (B)
- CABG surgery should be done at the same time as MR surgery (B)

The patient should be stabilized with an IABP, inotropic support and afterload reduction while emergency surgery is arranged.

2. Ventricular Septal Rupture (VSR)

- Patients with development of VSR should be considered for urgent cardiac surgical repair (B)
- CABG surgery should be done at the same time as repair of the VSR (B)

3. Left Ventricular Free-Wall Rupture

- Patients with free-wall rupture should be considered for urgent cardiac surgical repair (B)
- CABG surgery should be done at the same time as repair of the rupture (B)

Arrhythmias after STEMI

1. Ventricular Arrhythmias

- **Ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT)** should be treated with unsynchronized electric shock (monophasic shock energy 200 J); if unsuccessful, a second shock of 200-300 J; if necessary a third shock of 360 J.
- **Ventricular tachycardia (VT)**
 - Sustained polymorphic VT should be treated with electric shock as for VF (above)
 - Episodes of sustained monomorphic VT associated with angina, pulmonary edema, or hypotension should be treated with a synchronized electric shock of 100 J. Increasing energies may be used if not initially successful. Brief anesthesia is recommended. (B)
 - Sustained monomorphic VT not associated with above cardiac symptoms should be treated with
 - Amiodarone infusion (B)
 - Synchronized electrical cardioversion starting at 50 J; brief anesthesia is needed. (B)
- **Ventricular premature beats** - treatment of isolated ventricular premature beats, couplets, and nonsustained VT is not recommended unless they lead to hemodynamic compromise. (A)

An **implantable cardioverter-defibrillator (ICD)** is indicated for

- patients with VF or hemodynamically significant sustained VT > 2 days after STEMI, if arrhythmia is not due to transient or reversible ischemia or reinfarction. (A)
- patients without VF or sustained VT > 2 days after STEMI
 - whose STEMI occurred \geq 1 month ago

- Who have an LVEF less than 35%
- Who demonstrate additional evidence of electrical instability (*e.g.* nonsustained VT)
- Who have inducible VF or sustained VT on electrophysiological testing. (B)

2. Supraventricular Arrhythmias/Atrial Fibrillation (AF)

- **Sustained AF and atrial flutter** in patients with hemodynamic compromise or ongoing ischemia should be treated with one or more of the following:
 - Synchronized cardioversion (C)
 - Antiarrhythmic pharmacologic therapy aimed at slowing the ventricular response (amiodarone; digoxin if patient has severe LV dysfunction and heart failure)(C)
- **Sustained AF and flutter** in patients with ongoing ischemia but no hemodynamic compromise should be treated with one or more of the following:
 - Beta –adrenergic blockade unless contraindicated (C)
 - Intravenous diltiazem or verapamil (C)
 - Synchronized cardioversion (C)
- **Sustained AF or flutter** without hemodynamic compromise or ischemia
 - rate control is indicated
 - anticoagulant therapy
 - consider cardioversion if patient had history of AF or flutter prior to STEMI.
- **Reentrant paroxysmal supraventricular tachycardia** should be treated with the following sequence:
 - Carotid sinus massage (C)
 - Intravenous adenosine (C)
 - Intravenous beta-adrenergic blockade with metoprolol (C)
 - Intravenous diltiazem (C)
 - Intravenous digoxin (C)

3. Conduction Disturbances and Bradyarrhythmias

- **Ventricular Asystole** should be treated by administration of prompt resuscitative measures including (B)
 - Chest compressions,
 - Atropine
 - Vasopressin
 - Epinephrine
 - Temporary pacing.
 - **Permanent ventricular pacing** is indicated for
 - Persistent second-degree AV block in the HIS-Purkinje system with bilateral bundle-branch block or third degree AV block within or below the His-Purkinje system. (B)
 - Transient advanced second-or-third-degree infranodal AV block and associated bundle-branch block (B)
 - Persistent and symptomatic second-or-third-degree AV block. (C)
- All patients who have an indication for permanent pacing after STEMI should be evaluated for ICD indications. (C)
- **Sinus node dysfunction** - symptomatic sinus bradycardia or sinus pauses >3 seconds should be treated with IV bolus of atropine 0.6-1.0 mg. If bradycardia is persistent after maximal atropine doses (2 mg.), transcutaneous or transvenous temporary pacing should be instituted. (C)¹³

Recurrent Chest Pain after STEMI

The two most common causes are pericarditis and recurrent ischemia.

1. Pericarditis

occurs with extension of necrosis across the full thickness of the myocardial wall to the epicardium.

- **Aspirin** is recommended for treatment of pericarditis; doses as high as 650 mg. orally every 4-6 hours may be needed. (B)
- Anticoagulation should be immediately discontinued if pericardial effusion develops or increases.

2. **Recurrent ischemia/infarction** is the more likely diagnosis when the chest pain is similar to the initial ischemic-type chest discomfort. Management measures include
 - Escalation of medical therapy with nitrates and beta-blockers to decrease myocardial oxygen demand and reduce ischemia. IV anticoagulation should be initiated if not already accomplished. (B)
 - Urgent referral for cardiac catheterization and revascularization as needed for patients with recurrent ischemic-type chest discomfort and signs of hemodynamic instability, poor LV function, or a large area of myocardium at risk. Insertion of an IABP should be considered. (C)
 - Coronary arteriography and PCI or CABG as dictated by coronary anatomy for patients considered candidates for revascularization. (B)

Other Complications

1. **Ischemic Stroke** – STEMI patients who have an acute ischemic stroke should
 - Have neurological consultation. (C)
 - Be evaluated with echocardiography, neuroimaging, and vascular imaging studies to determine the cause of the stroke. (C)
 - Receive lifelong warfarin therapy (moderate-intensity INR 2-3) if persistent AF present (A)
2. **DVT and Pulmonary Embolism** after STEMI
 - should be treated with full-dose LMWH (low-molecular-weight heparin) for a minimum of 5 days and until patient is adequately anticoagulated with warfarin. Start warfarin concurrently with LMWH and titrate to INR of 2-3. (A)
 - Patients with HF after STEMI who are hospitalized for prolonged periods, unable to ambulate, or considered at high risk for DVT and are not otherwise anticoagulated should receive low-dose heparin prophylaxis, preferably with LMWH. (A)

CABG Surgery after STEMI

Elective CABG surgery after STEMI in patients with stable angina is highly recommended for patients who have significant left main coronary artery stenosis. (A) Should be seriously considered for the following:

- left main equivalent disease: significant ($\geq 70\%$) stenosis of the proximal left anterior descending coronary artery and proximal left circumflex artery. (A)
- 3-vessel disease. (A)
- 1-or-2-vessel coronary disease without significant proximal left anterior descending coronary artery stenosis but with a large area of viable myocardium and high-risk criteria on noninvasive testing. (B)
- 2-vessel disease with significant proximal left anterior descending coronary artery stenosis and either LVEF < 0.50 or demonstrable ischemia on noninvasive testing. (A)

CONVALESCENCE, DISCHARGE AND POST-MI CARE

Risk Stratification at Discharge

1. **Coronary Arteriography** should be performed
 - In patients with spontaneous episodes of myocardial ischemia or episodes provoked by minimal exertion during recovery from STEMI. (A)
 - For intermediate-or-high-risk findings on noninvasive testing after STEMI. (B)
 - Before definitive therapy of a mechanical complication of STEMI if patient is sufficiently stable. (B)
 - In patients with persistent hemodynamic instability. (B)
 - In survivors of STEMI who had clinical heart failure acutely but subsequently demonstrated well-preserved LV function. (A)

Coronary arteriography should not be performed in survivors of STEMI who are not candidates for coronary revascularization. (A)

2. **LV Function (LV ejection fraction/EF)**
 - LVEF should be measured in all STEMI patients as an accurate predictor of future cardiac events. (B)
 - LV function can be measured by either echocardiography or radionuclide imaging if patient has not been selected for cardiac catheterization.

3. Exercise testing

- Should be performed in hospital or early after discharge to assess presence/extent of inducible ischemia in STEMI patients who are
 - Not selected for cardiac catheterizations
 - Without high risk features (B)
- Echocardiography or myocardial perfusion imaging should be added to standard exercise testing when baseline abnormalities compromise ECG interpretation. (C).
- Should not be used for risk stratification in patients with STEMI who have been selected for cardiac catheterization (C)

Exercise testing after STEMI is used to

- Assess functional capacity and patient's ability to perform home/work tasks
- Establish exercise parameters for cardiac rehabilitation
- Evaluate efficacy of current medical regimen
- Risk-stratify for likelihood of subsequent cardiac event
- Evaluate chest pain symptoms after STEMI
- Provide reassurance to patients regarding their functional capacity as a guide to returning to work.

4. Echocardiography should be used

- In patients with STEMI not undergoing angiography to assess baseline LV function, especially if the patient is hemodynamically unstable. (C)
- To evaluate patients with inferior STEMI, clinical instability, and suspicion of RV infarction. (C)
- In patients with STEMI to evaluate suspected complications. (C)

Stress echocardiography should be used when needed for assessment for inducible ischemia.

5. Exercise Myocardial Perfusion Imaging

- Dipyridamole or adenosine stress perfusion nuclear scintigraphy or dobutamine echocardiography should be used in patients not undergoing cardiac catheterization to look for inducible ischemia in patients judged to be unable to exercise. (B)

Approach to Need for Catheterization and Revascularization after STEMI

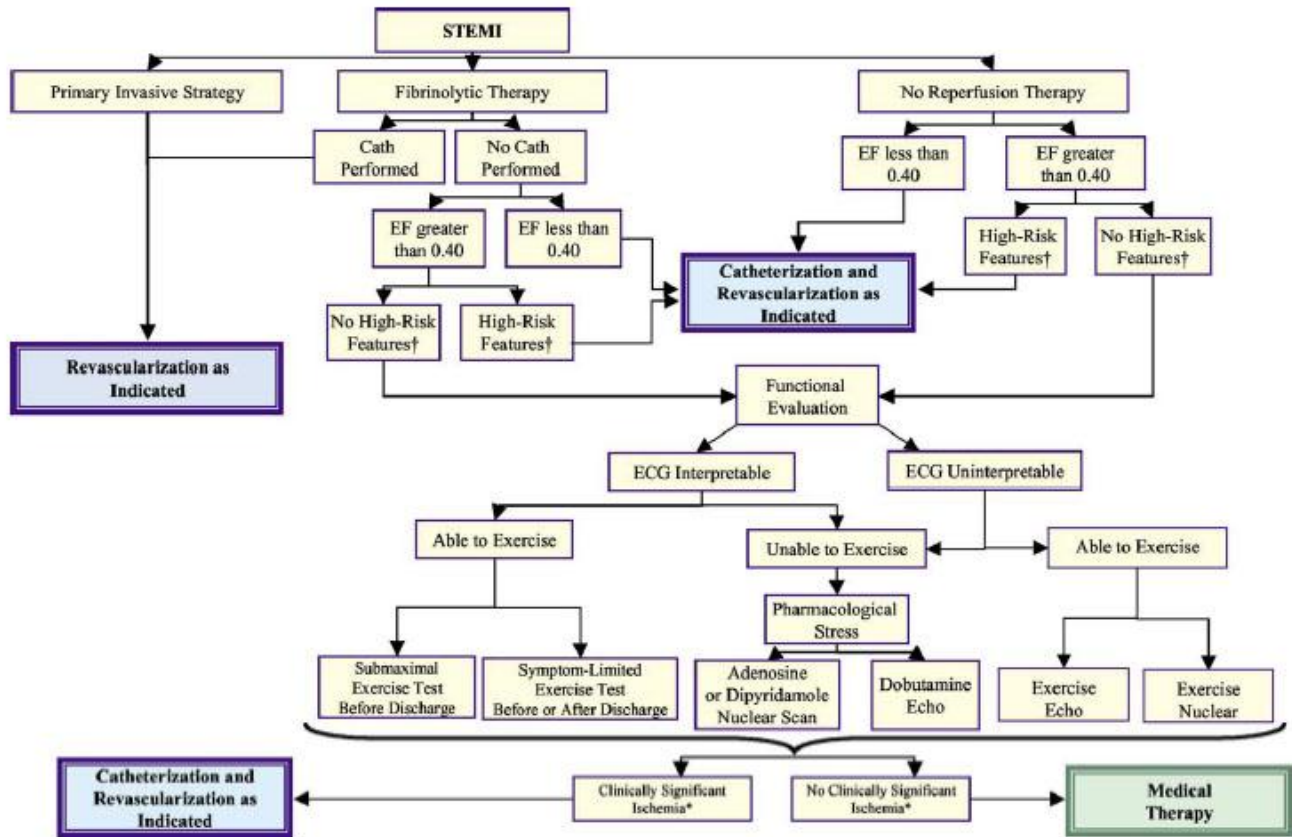


Figure 6. Evidence-based approach to need for catheterization (cath) and revascularization after STEMI. This algorithm shows treatment paths for patients who initially undergo a primary invasive strategy, receive fibrinolytic therapy, or do not undergo reperfusion therapy for STEMI. Patients who have not undergone a primary invasive strategy and have no high-risk features should undergo functional evaluation with one of the noninvasive tests shown. When clinically significant ischemia is detected, patients should undergo catheterization and revascularization as indicated; if no clinically significant ischemia is detected, medical therapy is prescribed after STEMI. *Please see Table 23 of the ACC/AHA Guidelines for the Management of Patients With Chronic Stable Angina for further definition. †Please see Table 3, Section 6.3.1.6.2., and Section 7.3. in the full-text STEMI guidelines for further discussion. STEMI indicates ST-elevation myocardial infarction; EF, ejection fraction; ECG, electrocardiography.

Long-Term Medical Therapy and Secondary Prevention

Patients who survive the acute phase of STEMI should have plans initiated for secondary prevention therapies.

(A)

- Before hospital discharge, patients should be educated about and actively involved in planning for adherence to the lifestyle changes and drug therapies important for secondary prevention. (B)
- Patients and family members should receive discharge instructions about recognizing acute cardiac symptoms and appropriate actions to take in response. (C)
- Family members should be advised to learn about AEDs and CPR and be referred to a CPR training program. (C)

Secondary Prevention:

Goal	Action
Smoking Smoking cessation No exposure to environmental tobacco smoke	<ul style="list-style-type: none"> • Ask about status of tobacco use and exposure at every visit (B) • Advise patient and family members who smoke to quit at every visit (B) • Assess willingness to quit (B) • Assist quitting by counseling, pharmacological therapy, formal

	<p>smoking cessation programs as appropriate (B)</p> <ul style="list-style-type: none"> • Avoid exposure to tobacco smoke at home/work (B)
<p>Blood Pressure <140/90 <130/80 if chronic kidney disease or diabetes (A)</p>	<ul style="list-style-type: none"> • If BP >120/80, initiate lifestyle modification (weight control; increased physical activity; alcohol moderation; sodium reduction; increased consumption of fresh fruits, vegetables, low-fat dairy products). (B) • If BP \geq 140/90 (or 130/80) add BP medications, treating initially with beta blockers and/or ACE inhibitors (A)
<p>Lipid Management LDL-C <i>substantially</i> <100 if TG < 200 Non-HDL-C <i>substantially</i> <130 if TG \geq200</p>	<ul style="list-style-type: none"> • Assess fasting lipid profile in all patients within 24 hrs. of hospitalization; if appropriate, initiate lipid lowering medication before discharge. (A) • Start diet in all patients (<7% total calories as saturated fat, <200 mg. cholesterol (B) • Promote physical activity and weight management (B) • If baseline LDL-C \geq100 initiate LDL-lowering drug therapy (A) • IF LDL-C \geq100 on therapy, intensify LDL-lowering drug therapy (A) • If TG \geq150 or HDL-C <40, emphasize weight management, physical activity, smoking cessation,(B) • IF TG 200-499, non-HDL-C target is <130 (B); intensify LDL-C-lowering therapy to reduce non-HDL-C. (B) • If TG \geq500, use fibrate or niacin to prevent pancreatitis before LDL-lowering therapy is initiated. (C)
<p>Physical Activity 30 minutes, 7 days/week (minimum 5d/wk)</p>	<ul style="list-style-type: none"> • Advise medically supervised programs (cardiac rehabilitation) for post-STEMI patients (B) • Assess risk with exercise test or equivalent to guide prescription (see above “Exercise testing”) (B) • Encourage 30-60 minutes of moderate-intensity aerobic activity most/all days of week, supplemented by increase in daily lifestyle activities (B)
<p>Weight Management BMI 18.5-24.9 Waist circumference (WC) Men <40 in. Women <35 in.</p>	<ul style="list-style-type: none"> • Assess BMI and/or waist circumference on each visit • Encourage weight maintenance/reduction at each visit • Initial goal of weight loss therapy is to reduce body weight by 10% from baseline. (B) • If WC \geq35 (women) or \geq40 (men), initiate lifestyle changes and consider treatment for metabolic syndrome as indicated. (B)
<p>Diabetes Management Goal HbA1c <7%</p>	<ul style="list-style-type: none"> • Initiate lifestyle and pharmacotherapy to achieve near-normal HbA1c (B) • Begin modification of other risk factors as appropriate
<p>Antiplatelet Agents: Aspirin</p>	<ul style="list-style-type: none"> • Post-PCI STEMI stented patients without aspirin resistance, allergy or increased risk of bleeding should be given aspirin 162-325 mg. daily for 1 month after bare metal stent (BMS) implantation 3 months after sirolimus-eluting stent implantation (DES) 6 months after paclitaxel-eluting stent implantation (DES) (B) • Aspirin use should then be continued indefinitely at a dose of 75-162 mg. daily (B).
<p>Antiplatelet Agents: Clopidogrel</p>	<ul style="list-style-type: none"> • Post-PCI patients who receive a DES should be given clopidogrel 75 mg. daily for at least 12 months if not at high risk for bleeding.

	<ul style="list-style-type: none"> • Post-PCI patients who receive a BMS should be given clopidogrel 75mg. for at least 1 month. (If patient at increased risk of bleeding, give for minimum of 2 weeks.) (B) • Patients not undergoing stenting (medical therapy alone or PTCA without stenting) should be given clopidogrel for at least 14 days. (B)
Anticoagulants: Warfarin	<ul style="list-style-type: none"> • In post-MI patients when clinically indicated (AF, left ventricular thrombus), manage warfarin to an INR=2.0-3.0 (A). • Use of warfarin with aspirin and/or clopidogrel is associated with an increased risk of bleeding and should be closely monitored. (B) • In patients requiring warfarin, clopidogrel, and aspirin therapy, an INR of 2.0-2.5 is recommended with low-dose aspirin (75-81 mg) and a 75 mg. dose of clopidogrel. (C)
ACE Inhibitors	<p>ACE inhibitors should be started and continued indefinitely, unless contraindicated, in</p> <ul style="list-style-type: none"> • all patients recovering from STEMI with LVEF \leq40% • those with hypertension, diabetes, or chronic kidney disease, (A) • Post-STEMI patients who are not lower risk¹⁴ (B)
Angiotensin Receptor Blockers (ARBs)	<ul style="list-style-type: none"> • Use ARBs in patients who are intolerant of ACE inhibitors and have HF or have had an MI with LVEF \leq 40%.
Aldosterone Blockade	<p>Use aldosterone blockade in post-MI patients without significant renal dysfunction or hyperkalemia when</p> <ul style="list-style-type: none"> • Patient is already receiving therapeutic doses of an ACE inhibitor and beta blocker and • Patient has LVEF of \leq 40% and • Patient has diabetes or HF (A)
Beta Blockers	<ul style="list-style-type: none"> • Start and continue beta-blocker therapy indefinitely in all patients who have had MI, ACS, or LV dysfunction with or without HF symptoms, unless contraindicated. (A)
Hormone Therapy	<ul style="list-style-type: none"> • Hormone therapy with estrogen plus progestin should not be given de novo to postmenopausal women after STEMI for secondary prevention of coronary events. (A) • Postmenopausal women already taking estrogen + progestin at time of a STEMI should not continue hormone therapy. (B) • Women already taking such hormones for >1-2 years who wish to continue for another compelling indication should weigh risks and benefits; however, hormone therapy should not be continued while patients are on bedrest in hospital. (B)
Influenza Vaccine	<p>Post-STEMI patients should have an annual influenza vaccination. (B)</p>

Long-Term Management

A follow-up visit with the medical provider to assess progress should occur 3-6 weeks after hospital discharge.

Issues to be addressed at this visit include:

1. Presence or absence of cardiovascular symptoms and functional class. (C)
2. Evaluation of the patient's list of current medications, with appropriate titration of ACE inhibitors, beta-blockers, and statins. (C)
3. Review and continuation of pre-discharge risk assessment and planned workup. Include a check of LV function and possible Holter monitoring if early post-STEMI EF was 0.31 – 0.40 or lower in consideration of possible ICD use. (C)

4. Review of principles of secondary prevention with patient and family members. (C)
5. Evaluation of psychosocial status of patient, including inquiries regarding symptoms of depression, anxiety, or sleep disorders and the social support environment. (C)
6. Discussion in detail of
 - Physical activity
 - Return to work
 - Resumption of sexual activity
 - Travel, including driving and flying. (C)
7. Interest of patients and families for CPR training. (C)
8. Review with patients and families
 - Patient's heart attack risk. (C)
 - How to recognize symptoms of STEMI. (C)
 - Advisability of calling 911 if symptoms are unimproved or worsening after 5 minutes. (C)
 - Plan for appropriate recognition and response to a potential acute cardiac event.

SECTION IIIB: MANAGEMENT OF PATIENTS WITH UNSTABLE ANGINA (UA) AND NON-ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION (NSTEMI)

Unstable Angina/Non-ST-segment Elevation Myocardial Infarction (UA/NSTEMI) is a clinical syndrome subset of ACS that is usually, but not always, caused by atherosclerotic CAD. UA and NSTEMI are closely related but of differing severity; they differ primarily in whether the ischemia is severe enough to cause sufficient myocardial damage to release detectable quantities of a biomarker of myocardial injury.

PRE-HOSPITAL MANAGEMENT

See guidelines in section III/ACS (above)

EMERGENCY DEPARTMENT (ED) EVALUATION and IMMEDIATE MANAGEMENT

1. **Possible ACS** (recent episode of chest discomfort at rest but pain-free when evaluated, normal or unchanged ECG, no elevations of cardiac biomarkers)
 - **Observe** 12-24 hrs from symptom onset in facility with cardiac monitoring (chest pain unit or hospital telemetry unit), with continuous 12-lead ECG monitoring or repeat ECGs and repeat cardiac biomarker measurement at specified time intervals.
 - No recurrent pain, negative follow-up studies: **stress study** (exercise or pharmacological) to provoke ischemia should be performed in the ED, in a chest pain unit, or on an outpatient basis within 72 hr. (C)
 - If negative: arrangements for follow-up as outpatient within 3 days. (C)
 - If positive: admit to hospital for confirmed ACS
 - Recurrent ischemic pain or positive follow-up studies: Admit to hospital for confirmed ACS.
 - Low risk patients referred for outpatient stress testing should be given precautionary appropriate pharmacotherapy (e.g. ASA, sublingual NTG, and/or beta blockers) while awaiting results of stress test. (C)
2. **Definite ACS**
 - ST-elevation on ECG: evaluate for reperfusion therapy; manage as STEMI (A)
 - No ST-elevation on ECG:
 - ST and/or T wave changes, ongoing pain, positive cardiac biomarkers, and/or hemodynamic abnormalities: admit to hospital (critical care unit for patients with active, ongoing ischemia/injury or hemodynamic or electrical instability; telemetry step-down unit for others for management (see below). (C)
 - Nondiagnostic ECG, normal initial serum cardiac biomarkers: observe 12-24 hours and proceed as above for "possible ACS".

3. Patients discharged from ED or chest pain unit should be given specific instructions for activity, medications, additional testing, and physician follow-up. (C)

RISK STRATIFICATION

Short-Term Risk of Death or Nonfatal MI in Patients with UA/NSTEMI*

Feature	High Risk	Intermediate Risk	Low Risk
	<i>At least 1 of the following features must be present:</i>	<i>No high-risk feature, but must have 1 or the following:</i>	<i>No high- or intermediate-risk feature but may have any of the following features:</i>
History	Accelerating tempo of ischemic symptoms in preceding 48 h	Prior MI, peripheral or cerebrovascular disease, or CABG; prior aspirin use	
Character of pain	Prolonged ongoing (greater than 20 min) rest pain	Prolonged (greater than 20 min) rest angina, now resolved, with moderate or high likelihood of CAD Rest angina (greater than 20 min) or relieved with rest or sublingual NTG Nocturnal angina New-onset or progressive Canadian Cardiovascular Society (CCS) class III or IV angina in the past 2 weeks without prolonged (greater than 20 min) rest pain but with intermediate or high likelihood of CAD	Increased angina frequency, severity, or duration Angina provoked at a lower threshold New onset angina with onset 2 weeks to 2 months prior to presentation
Clinical findings	Pulmonary edema, most likely due to ischemia New or worsening mitral regurgitation (MR) murmur S ₃ or new/worsening rales Hypotension, bradycardia, tachycardia Age greater than 75 years	Age greater than 70 years	
ECG	Angina at rest with transient ST-segment changes greater than 0.5 mm Bundle-branch block, new or presumed new Sustained ventricular tachycardia	T-wave changes Pathological Q waves or resting ST-depression less than 1 mm in multiple lead groups (anterior, inferior, lateral)	Normal or unchanged ECG
Cardiac	Elevated cardiac troponin T	Slightly elevated cardiac TnT, TnI, or	Normal

	High Risk	Intermediate Risk	Low Risk
Feature	<i>At least 1 of the following features must be present:</i>	<i>No high-risk feature, but must have 1 or the following:</i>	<i>No high- or intermediate-risk feature but may have any of the following features:</i>
markers	(TnT), troponin I (TnI), or CK-MB (e.g., TnT or TnI greater than 0.1 ng per mL)	CK-MB (e.g., TnT > 0.01 < 0.1 ng per mL)	

*Estimation of the short-term risks of death and nonfatal cardiac ischemic events in UA (or NSTEMI) is a complex multivariable problem that cannot be fully specified in a table such as this; therefore, this table is meant to offer general guidance and illustration rather than rigid algorithms.

EARLY HOSPITAL CARE - UA/NSTEMI likely or definite

Selection of Initial Treatment Strategy: Invasive versus Conservative Strategy

In addition to the medical therapy outlined below, 2 treatment pathways have emerged for treating ACS patients:

- “invasive” strategy triages patients to undergo an invasive diagnostic evaluation without first getting a noninvasive stress test or without failing medical treatment; patient undergoes coronary angiography within 4-24 hr. of admission. These patients are also treated with the medical regimen outlined below, started either before diagnostic angiography or at the time of angiography (if urgent catheterization and revascularization is required).
- “conservative” strategy calls for initial medical management, with invasive evaluation only for those patients who fail medical therapy or in whom objective evidence of ischemia is identified.

Preferred Strategy	Patient Characteristics
Invasive	<ul style="list-style-type: none"> • Recurrent angina or ischemia at rest or with low-level activities despite intensive medical therapy • Elevated cardiac biomarkers (TnT or TnI) • New or presumably new ST-segment depression • Signs or symptoms of heart failure (HF) or new or worsening mitral regurgitation • High-risk findings from noninvasive testing • Hemodynamic instability • Sustained ventricular tachycardia • PCI within 6 months • Prior CABG • High risk score (e.g., TIMI, GRACE)¹⁵ • Reduced left ventricular function (left ventricular ejection fraction [LVEF] less than 40%)
Conservative	<ul style="list-style-type: none"> • Low risk score (e.g., TIMI, GRACE) • Patient or physician preference in the absence of high-risk features

Medical Therapy

Anti-Ischemic and Analgesic Therapy

1. **Bed/chair rest** with continuous ECG monitoring. (C)
2. **Supplemental oxygen** to patients with
 - arterial saturation <90%,
 - respiratory distress
 - other high-risk features for hypoxemia. (B)
3. **Sublingual NTG (0.4 mg.)** every 5 min. for total 3 doses in patients with ongoing ischemic discomfort, after which assessment should be made about the need for IV NTG. (C)

4. **Intravenous NTG** in first 48 hr. after UA/NSTEMI for treatment of
 - Persistent ischemia
 - Heart failure
 - Hypertension. (B)
5. Initiate **oral beta-blockers** within first 24 hr. to patients without a contraindication. (B)
6. If beta blockers are contraindicated and patient has continuing or frequently recurring ischemia, a **nondihydropyridine calcium channel blocker** should be given as initial therapy in the absence of clinically significant LV dysfunction or other contraindications. (B)
7. Administer **ACE inhibitor** orally within the first 24 hr. to patients with pulmonary congestion or LVEF ≤ 0.40 , in absence of hypotension or known contraindications. An ARB may be used for ACE intolerant patients. (A)

Antiplatelet/ Anticoagulant Therapy

1. **Aspirin:** administer as soon as possible after hospital presentation and continue indefinitely in patients not known to be intolerant of aspirin. (A)
2. **Clopidogrel** (loading dose followed by daily maintenance dose): administer to patients unable to take aspirin because of hypersensitivity or major gastrointestinal intolerance. (A)
 - In patients with a history of GI bleeding, when aspirin and clopidogrel are administered alone or in combination, prescribe drugs to minimize risk of GI bleeding. (B)
3. **Anticoagulant therapy** should be added to antiplatelet therapy as soon as possible after presentation.
4. **Patients with initial invasive strategy:**
 - Initiate therapy with aspirin and either clopidogrel or an intravenous GP IIb/IIIa before diagnostic angiography (A).
 - Initiate anticoagulant regimen; options include enoxaparin or unfractionated heparin (UFH) (A), bivalirudin or fondaparinux (B).
5. **Patients with initial conservative strategy:**
 - Add clopidogrel to aspirin therapy as soon as possible after admission and administer for at least 1 month (A) and ideally up to 1 year. (B)
 - Initiate anticoagulant regimen; options include enoxaparin or unfractionated heparin (UFH) (A), or fondaparinux (B). In patients with increased risk of bleeding, fondaparinux is preferable if any treatment is to be given. (B)
6. **Ongoing management considerations (antiplatelet/anticoagulant):**
 - **Initial conservative strategy and no subsequent features necessitating angiography:** perform stress test. (B)
 - If testing indicates “not low risk”, perform diagnostic angiography. (A)
 - If testing indicates “low risk”, then
 - Continue aspirin indefinitely (A)
 - Continue clopidogrel for at least 1 month (A) and ideally up to 1 year (B)
 - Discontinue IV GP IIb/IIIa inhibitor if started previously (A)
 - Continue UFH for 48 hr. or administer enoxaparin or fondaparinux for duration of hospitalization (up to 8 d); then discontinue (A).
 - **Initial conservative strategy with appearance of recurrent symptoms/ischemia, heart failure, or serious arrhythmias:** perform diagnostic angiography (A)
 - **Post-angiography – CABG:**
 - Continue aspirin (A)
 - Discontinue clopidogrel 5-7 d. before elective CABG (B); more urgent surgery, if necessary, may be performed by experienced surgeons if the increased bleeding risk is considered acceptable. (C)
 - Discontinue IV GP IIb/IIIa inhibitor 4 h. before CABG. (B)
 - Manage anticoagulant therapy as follows:
 - Continue UFH (B)

- Discontinue enoxaparin 12-24 hr. before CABG and dose with UFH per institutional practice (B)
- Discontinue fondaparinux 24 hr. before, dose with UFH (B)
- Discontinue bivalirudin 3 hr. before, dose with UFH (B)
- **Post-angiography – PCI**
 - Continue aspirin (A)
 - Administer a loading dose of clopidogrel if not started before diagnostic angiography (A)
 - Administer an intravenous GP IIb/IIIa inhibitor if not started before diagnostic angiography for troponin-positive and other high-risk patients (A)
 - Discontinue anticoagulant therapy after PCI for uncomplicated cases (B).
- **Post-angiography – Medical Therapy**
 - No significant obstructive CAD on angiography: administer antiplatelet and anticoagulant therapy at discretion of the clinician. (C)
 - CAD found on angiography:
 - Continue aspirin (A)
 - Administer loading dose of clopidogrel if not given before angiography (A)
 - Discontinue IV GP IIb/IIIa inhibitor if started previously. (B)
 - Manage anticoagulant therapy as follows: continue UFH for 48 hr. or continue enoxaparin or fondaparinux for duration of hospitalization (up to 8 d); then discontinue (A).

Measurement of LV Function

For patients where initial conservative strategy is selected and no subsequent features appear that necessitate angiography, LVEF should be measured. (B)

RISK STRATIFICATION BEFORE DISCHARGE

The management of ACS patients requires continuous risk stratification. Patients at high risk for adverse outcomes should be considered for early coronary angiography without noninvasive stress testing. However, the majority of patients presenting with UA/NSTEMI are reasonable candidates for risk stratification with noninvasive testing.

1. **Noninvasive stress testing** is recommended in
 - low-risk patients (See Table above: Short-Term Risk of Death or Nonfatal MI in Patients With UA/NSTEMI) who have been free of ischemia at rest or with low-level activity and of HF for a minimum of 12 to 24 h. (C)
 - patients at intermediate risk who have been free of ischemia at rest or with low-level activity and of HF for a minimum of 12 to 24 h. (C)
2. **Choice of stress test** is based on the resting ECG, ability to perform exercise, local expertise, and technologies available.
 - Treadmill exercise test is useful in patients able to exercise in whom the ECG is free of baseline ST-segment abnormalities, bundle-branch block, LV hypertrophy, intraventricular conduction defect, paced rhythm, preexcitation, and digoxin effect. (C)
 - An imaging modality should be added in patients who are able to exercise and with resting ST-segment depression (greater than or equal to 0.10 mV), LV hypertrophy, bundle-branch block, intraventricular conduction defect, preexcitation, or digoxin.
 - In patients undergoing a low-level exercise test, an imaging modality can add sensitivity. (B)
 - Pharmacological stress testing with imaging is recommended when physical limitations (e.g., arthritis, amputation, severe peripheral vascular disease, severe chronic obstructive pulmonary disease, or general debility) preclude adequate exercise stress. (B)
3. **Prompt angiography** without noninvasive risk stratification should be performed for failure of stabilization with intensive medical treatment. (B)

4. **A noninvasive test (echocardiogram or radionuclide angiogram)** is recommended to evaluate LV function in patients with definite ACS who are not scheduled for coronary angiography and left ventriculography. (B)

CORONARY REVASCULARIZATION

Coronary revascularization (PCI or CABG) is performed to improve prognosis, relieve symptoms, prevent ischemic complications, and improve functional capacity. The indications for coronary revascularization for patients with UA/NSTEMI are similar to those for patients with chronic stable angina (see Section II, above).

PCI is indicated for UA/NSTEMI patients

- who have no serious comorbidity and who have coronary lesions amenable to PCI and any high-risk features (see Table “Short term risk...” above)

An intravenous platelet GP IIb/IIIa inhibitor recommended in UA/NSTEMI patients undergoing PCI. (A)

PCI or CABG is indicated for UA/NSTEMI patients

- with 1-or-2-vessel CAD with or without significant proximal left anterior descending CAD but with large area of viable myocardium and high-risk criteria on noninvasive testing. (B)
- with multivessel coronary disease with suitable coronary anatomy, with normal LV function, and without diabetes mellitus. (A)

CABG is indicated for UA/NSTEMI patients

- with significant left main CAD (> 50% stenosis). (A)
- with 3-vessel disease; survival benefit is greater in patients with LVEF < 0.50 (A)
- with 2-vessel disease with significant proximal left anterior descending CAD and either LVEF < 0.50 or ischemia on noninvasive testing (A)

HOSPITAL DISCHARGE AND POST-HOSPITAL CARE

Hospital Course

The acute phase of UA/NSTEMI (*i.e.* highest risk of progression to MI, development of recurrent MI, or death) is usually over within 2 months. Within 1-3 months after the acute phase, most patients resume a clinical course similar to that in patients with chronic stable coronary disease. The usual hospital course for patients hospitalized for UA/NSTEMI is as follows:

- Patients who have undergone **successful PCI** with uncomplicated course are discharged the next day
- Patients who undergo **uncomplicated CABG** are discharged 4-7 days after CABG
- **Medical management of patients who are low-risk** after noninvasive stress testing and/or coronary angiography is usually accomplished rapidly, with discharge soon after testing.
- **Medical management of high-risk patients** who are unsuitable for or unwilling to undergo revascularization may require inpatient monitoring to achieve adequate ischemic symptom control.

Medical Regimen and use of Medications

- Continue medications to control ischemia in
 - Patients who do not undergo coronary revascularization
 - Patients with unsuccessful revascularization
 - Patients with recurrent symptoms after revascularization. (C)
- Inform patients about symptoms of worsening myocardial ischemia and MI and instruct in how/when to seek emergency care and assistance if such symptoms occur. (C)
- Provide patients and/or caregivers with instructions about medication type, purpose, dose, frequency, pertinent side effects. (C)
- Educate patient/family/caregiver on secondary prevention therapies (below)
- Instruct patients in management of anginal discomfort lasting >2-3 min., *e.g.*
 - Discontinue physical activity or leave stressful event.
 - Take 1 dose NTG if pain does not subside immediately
 - If chest discomfort/pain unimproved 5 min. after 1 NTG dose, call 911 to access EMS
 - Take addition NTG (at 5 min intervals x2) while activating EMS (C)

- If pattern or severity of anginal symptoms changes (e.g. pain more frequent/severe/at rest) patient should contact his/her physician to assess need for additional treatment/testing. (C)

Long-term Medical Therapy and Secondary Prevention

Goal	Action
Smoking Smoking cessation No exposure to environmental tobacco smoke	<ul style="list-style-type: none"> • Ask about status of tobacco use and exposure at every visit (B) • Advise patient and family members who smoke to quit at every visit (B) • Assess willingness to quit (B) • Assist quitting by counseling, pharmacological therapy, formal smoking cessation programs as appropriate (B) • Avoid exposure to tobacco smoke at home/work (B)
Blood Pressure <140/90 <130/80 if chronic kidney disease or diabetes (A)	<ul style="list-style-type: none"> • If BP >120/80, initiate lifestyle modification (weight control; increased physical activity; alcohol moderation; sodium reduction; increased consumption of fresh fruits, vegetables, low-fat dairy products). (B) • If BP \geq 140/90 (or 130/80) add BP medications, treating initially with beta blockers and/or ACE inhibitors (A)
Lipid Management LDL-C <i>substantially</i> <100 if TG < 200 Non-HDL-C <i>substantially</i> <130 if TG \geq 200	<ul style="list-style-type: none"> • Assess fasting lipid profile in all patients within 24 hrs. of hospitalization (A) • Initiate statins in the absence of contraindications, regardless of baseline LDL-C and diet modification. (A) • For hospitalized patients, lipid-lowering medications should be initiated before discharge. (A) • Start diet in all patients (<7% total calories as saturated fat, <200 mg. cholesterol (B) • Promote physical activity and weight management (B) • If baseline LDL-C \geq100 initiate LDL-lowering drug therapy (A) • IF LDL-C \geq100 on therapy, intensify LDL-lowering drug therapy (A) • If TG \geq150 or HDL-C <40, emphasize weight management, physical activity, smoking cessation.(B) • IF TG 200-499, non-HDL-C target is<130 (B); intensify LDL-C-lowering therapy to reduce non-HDL-C. (B) • If TG\geq500, use fibrate or niacin to prevent pancreatitis before LDL-lowering therapy is initiated. (C)
Physical Activity 30 minutes, 7 days/week (minimum 5d/wk)	<ul style="list-style-type: none"> • Advise medically supervised programs (cardiac rehabilitation) for UA/NSTEMI patients (B) • Assess risk with exercise test or equivalent to guide prescription (B) • Encourage 30-60 minutes of moderate-intensity aerobic activity most/all days of week, supplemented by increase in daily lifestyle activities (B)
Weight Management BMI 18.5-24.9 Waist circumference (WC) Men <40 in.	<ul style="list-style-type: none"> • Assess BMI and/or waist circumference on each visit • Encourage weight maintenance/reduction at each visit • Initial goal of weight loss therapy is to reduce body weight by 10% from baseline. (B)

Women <35 in.	<ul style="list-style-type: none"> If WC ≥ 35 (women) or ≥ 40 (men), initiate lifestyle changes and consider treatment for metabolic syndrome as indicated. (B)
Diabetes Management Goal HbA1c <7%	<ul style="list-style-type: none"> Initiate lifestyle and pharmacotherapy to achieve near-normal HbA1c (B) Begin modification of other risk factors as appropriate
Antiplatelet Agents: Aspirin	<ul style="list-style-type: none"> Medically treated patients: aspirin (75-162 mg/d) indefinitely (A) Post-PCI stented patients without aspirin allergy: aspirin 162-325 mg. daily for 1 month after BMS implantation (B) 3 months after sirolimus-eluting stent implantation 6 months after paclitaxel-eluting stent implantation (B) Aspirin use should then be continued indefinitely at a dose of 75-162 mg. daily (A).
Antiplatelet Agents: Clopidogrel	<ul style="list-style-type: none"> Medically treated patients : clopidogrel (75 mg/d) for at least 1 month (A) and ideally up to 1 yr. (B) Post-PCI stented patients: clopidogrel (75 mg/d) for 1 mo. (minimal) – 1 yr. (ideal) after BMS implantation 12 mo. after DES implantation (B) If patient at increased risk of bleeding: give clopidogrel for a minimum of 2 weeks (B) Patients where aspirin contraindicated or not tolerated: clopidogrel 75 mg/d (B)
Anticoagulants: Warfarin	<ul style="list-style-type: none"> Use of warfarin with aspirin and/or clopidogrel is associated with an increased risk of bleeding and should be closely monitored. (B)
ACE Inhibitors	<ul style="list-style-type: none"> ACE inhibitors should be started and continued indefinitely, unless contraindicated, in all patients recovering from UA/NSTEMI with heart failure, LVEF $\leq 40\%$, hypertension, or diabetes (A)
Angiotensin Receptor Blockers (ARBs)	<ul style="list-style-type: none"> Use ARBs in patients who are intolerant of ACE inhibitors and who have HF or LVEF $\leq 40\%$. (A) Long-term ARB for UA/NSTEMI patients already on ACE inhibitor who have LVEF ≤ 0.40 and HF or diabetes (if no significant renal dysfunction or hyperkalemia) (A)
Nitroglycerin	<ul style="list-style-type: none"> All post-UA/NSTEMI patients should be given sublingual or spray NTG and instructed in its use. (C)
Beta Blockers	<ul style="list-style-type: none"> Start and continue beta-blocker therapy indefinitely in all patients who have had MI, ACS, or LV dysfunction with or without HF symptoms, unless contraindicated. (B)
Calcium Channel Blockers	<ul style="list-style-type: none"> Calcium channel blockers for ischemic symptoms when beta blockers are not successful, are contraindicated, or cause unacceptable side effects. (C)
Hormone Therapy	<ul style="list-style-type: none"> Hormone therapy with estrogen plus progestin should not be given de novo to postmenopausal women after UA/NSTEMI for secondary prevention of coronary events. (A) Postmenopausal women already taking estrogen + progestin at time of UA/NSTEMI should not continue hormone therapy. (B)

	<ul style="list-style-type: none"> • Women already taking such hormones for >1-2 years who wish to continue for another compelling indication should weigh risks and benefits; however, hormone therapy should not be continued while patients are on bedrest in hospital. (B)
Nonsteroidal Anti-Inflammatory Drugs	<ul style="list-style-type: none"> • Assess patient's need for treatment of chronic musculoskeletal discomfort; begin pain relief treatment with acetaminophen, small doses of narcotics, or nonacetylated salicylates. (C)
Influenza Vaccine	<ul style="list-style-type: none"> • Patients with cardiovascular disease should have an annual influenza vaccination. (B)

Long-Term Management

1. **A follow-up visit** with a medical provider to assess progress should occur
 - In 2-6 weeks for low-risk medically treated patients and revascularized patients
 - Within 14 d. for higher risk patients.

Issues to be addressed at this visit include:

- Presence and severity of angina
 - Evaluation of the patient's list of current medications
 - Review of principles of secondary prevention with patient and family members. (C)
 - Evaluation of psychosocial status of patient, including inquiries regarding symptoms of depression, anxiety, or sleep disorders and the social support environment. (C)
 - Discussion in detail of
 1. Physical activity: daily walking encouraged immediately; other activity based on results of graded exercise testing
 2. Return to work: based on patient's medical condition and employer regulations
 3. Resumption of sexual activity: within 7-10 d with usual partner for stable patients without complications
 4. Travel, including driving (1-3 weeks after discharge IF in compliance with individual state laws) and flying. (C)

Patients with UA who are revascularized and otherwise stable may accelerate return to above activities (often within a few days).
2. **Coronary angiography** is recommended for patients managed initially with medical strategy who experience recurrent signs/symptoms of UA or severe chronic stable angina despite medical management, if patient is suitable for revascularization. (B)
 3. **Long-term medical therapy for stable CAD** is recommended for patients who have tolerable stable angina or no anginal symptoms at follow-up visits. (B)
 4. **Effective communication** between patient and health care team is needed to enhance long-term compliance with prescribed therapies and recommended lifestyle changes. (B) Telephone follow-up can reinforce in-hospital and visit instruction, provide reassurance, and answer patient's questions (*e.g.* weekly calls for first 4 weeks after hospital discharge).

MANAGEMENT OF UA/NSTEMI in SPECIAL GROUPS

1. **Women:** recommendations same as for men. (B)
2. **Diabetes Mellitus:**
 - Medical treatment and management decisions similar in patients with and without diabetes. (A)
 - Aggressive glycemic management is a goal of therapy.(B)
3. **Older adults:**
 - Evaluation for appropriate therapeutic interventions similar to younger patients. (A)
 - Decisions on management should be patient-centered, not based solely on age. (B)
 - Attention should be given to appropriate dosing of pharmacological agents. (B)
 - Benefits from invasive strategies are equal to or perhaps greater in older adults and are recommended, in spite of increased early procedural risks with revascularization. (B)

4. Chronic Kidney Disease:

- Creatinine clearance should be estimated and doses of renally-cleared drugs adjusted. (B)
- If patient undergoing angiography, isosmolar contrast agents are indicated and preferred. (A)

5. Cocaine and Methamphetamine Users:

- Administration of sublingual or intravenous NTG and IV or oral calcium channel blockers is recommended for patients with ST-segment elevation or depression that accompanies ischemic chest discomfort after cocaine use. (C)
- Immediate coronary angiography should be performed in these patients if ST segments remain elevated after NTG and calcium channel blockers; PCI is recommended if occlusive thrombus detected. (C)
- Fibrinolytic therapy is useful if ST segments remain elevated after NTG and calcium channel blockers if coronary angiography is not possible and there are no contraindications. (C)

6. Variant (Prinzmetal’s) Angina:

- Diagnostic investigation for presence of transient myocardial ischemia and ST-segment elevation during chest pain is indicated in patients with clinical picture suggestive of coronary spasm. (A)
- Coronary angiography recommended for patients with episodic chest pain accompanied by transient ST-segment elevation. (B)
- Treatment with nitrates and calcium channel blockers recommended in patients with variant angina when angiogram shows no or nonobstructive coronary artery lesions.(B)
- Consider treatment with statins.

7. Cardiovascular “Syndrome X”

- Medical therapy with nitrates, beta blockers, statins, and calcium channel blockers, alone or in combination, is recommended for patients with cardiovascular syndrome X. (B)
- Risk factor reduction is recommended. (B)

¹ Go to www.nhlbi.nih.gov; choose “Public/heart and vascular diseases”, then choose “Public Online Version of 10 year heart attack risk calculator”

² See the following guidelines for management of specific risk factors: NHPRI Guideline for Tobacco Cessation for Adults; NHPRI Guidelines for Diabetes Care; Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; Third report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults

³ Ibid

⁴ Alternative diagnoses to angina for patients with chest pain:

Nonischemic cardiac	Pulmonary	Gastrointestinal	Chest wall	Psychiatric
Aortic dissection Pericarditis	Pulmonary embolus Pneumothorax Pneumonia Pleuritis	Esophagitis Esophageal spasm Esophageal reflux Biliary colic Cholecystitis Choledocholithiasis Cholangitis Peptic ulcer Pancreatitis	Costochondritis Fibrositis Rib fracture Sternoclavicular arthritis Herpes zoster (before rash)	Anxiety disorders <ul style="list-style-type: none"> • Hyperventilation • Panic disorder • Primary anxiety Affective disorders Somatiform disorders Thought disorders

⁵ Conditions provoking or exacerbating myocardial ischemia

Increased oxygen demand on heart	Decreased myocardial oxygen supply
Hyperthermia	Anemia
Hyperthyroidism	Hypoxemia
Sympathomimetic toxicity (e.g. cocaine use)	Sickle cell disease
Hypertension	Sympathomimetic toxicity
Anxiety	Hyperviscosity
Arteriovenous fistulae	Polycythemia
Hypertrophic cardiomyopathy	Aortic stenosis
Aortic stenosis	Hypertrophic cardiomyopathy
Dilated cardiomyopathy	
Tachycardia (ventricular or supraventricular)	

⁶ Canadian Cardiovascular Society Classification System:

Class I – Angina with strenuous, rapid or prolonged exertion at work or recreation. Ordinary physical activity does not cause angina, such as walking, climbing stairs.

Class II – Slight limitation of ordinary activity – occurs on walking or climbing stairs rapidly, walking uphill, walking after meals or in cold or wind or under emotional stress.

Class III – Marked limitations of ordinary physical activity.

Class IV – inability to carry on any physical activity without discomfort; anginal symptoms may be present at rest.

⁷ See NHPRI Guideline for Smoking Cessation in Primary Care.

⁸ Patient education materials from the NHAAP/AHA “Act in Time” campaign are available at www.nhlbi.nih.gov/actintime

⁹ “Skilled PCI laboratory” implies operator experience >75 primary PCI cases per year; team experience >200 PCI procedures per year, of which at least 36 are primary PCI for STEMI.

¹⁰ Ibid

¹¹ See ACC/AHA/ASNC Guidelines for the Clinical Use of Cardiac Radionuclide Imaging.

¹² See ACC/AHA/ASE 2003 Guideline Update for the Clinical Application of Echocardiography

¹³ See ACC/AHA Guidelines for Implantation of Pacemakers

¹⁴ “Lower risk” defined as those with normal LVEF in whom cardiovascular risk factors are well controlled and revascularization has been performed.

¹⁵ TIMI risk calculator available at <http://www.timi.org/>

GRACE clinical application tool available at <http://www.outcomes-umassmed.org/grace>