UCLA Clinical Practice Guidelines
for Acute Myocardial Infarction

I. Introduction

Acute myocardial infarction most often result from disruption of an atherosclerotic plaque and the subsequent cascade of pathologic processes that critically decrease coronary blood flow. The certainty of diagnosis, severity of symptoms, hemodynamic state, and medical history will determine the choice and timing of therapies used in individual patients. Patients with acute myocardial infarction require rapid initiation of therapy aimed at achieving reperfusion. This guideline describes principles of patient care derived from systematic analysis of scientific literature, expert opinion, and the ACC/AHA Acute Myocardial Infarction Clinical Practice Guideline. The diagnostic and management strategies recommended are designed to be efficacious, efficient, reasonable, and as safe as possible given the current state of medical knowledge.

Supporting rationale in italics.

I. Initial Diagnostic Assessment

Time is essential. All patients presenting with acute myocardial infarction who are appropriate candidates should receive direct catheterization or thrombolytic therapy as rapidly as possible, preferably within 30 minutes of arrival. This necessitates that all patients suspected of having myocardial infarction receive rapid triage and assessment.

A. History and Physical Exam

1) History of ischemic heart disease, ventricular function, disease severity, and cardiac risk factors
2) Acute heart failure or cardiogenic shock (BP, HR, exam)
3) Valvular heart disease
4) Arrhythmias
5) Complicating non-cardiac disease - including renal failure, advanced liver disease, respiratory insufficiency, coagulation abnormalities, diabetes, gastrointestinal bleeding, hypertension, cerebrovascular disease.

B. Laboratory Assessment

1) Electrocardiogram: rapid and accurate interpretation

2) Routine: CBC with platelets, creatinine, glucose, PT, PTT, nonfasting lipid panel

A nonfasting lipid panel obtained in the first 6-12 hours after the onset of acute myocardial infarction has been shown to be accurate. Subsequently, the acute phase reaction which can begin at 12-24 hours and can take up to 6 weeks to reverse, can lower LDL levels by 25-50%. Lipid panels obtained 12 hours or more after an acute event or after CABG should be interpreted with caution, recognizing the steady state LDL is likely to be much higher (as will the statin dose needed to achieve LDL < 100 mg/dl). If a lipid panel is not obtained on admission or in the first few hours of hospitalization, empiric statin initiation and dosing is recommended.

3) Specific indications:
   a) Arterial blood gases - in presence of significant respiratory disease, low output syndrome (oliguria, hypotension, evidence of peripheral or central hypoperfusion)
   b) Potassium, other electrolytes, magnesium - Hx of diuretic, digitalis, antiarrhythmic or ACE inhibitor Rx;
presence of insulin-dependent diabetes, congestive heart failure, renal disease, liver disease, low output syndrome, cardiac arrhythmias, prolonged QT, abnormal cardiac conduction, mental status change, GI electrolyte loss
c) Ca/PO$_4$ - specific disorder of calcium phosphate homeostasis or syndrome of abnormal retention or excretion/loss of Ca/PO$_4$.
d) Liver chemistries - known liver disease or clinical evidence thereof, right heart failure, hepatotoxic drugs, low output syndrome.
e) Chest x-ray - PA & lateral in ER when obvious and clinically complicating pulmonary disease present, or if aortic aneurysm suspected. For routine, AP portable in CCU/COU (to avoid ER delay).

4) Diagnostic and prognostic tests.
a) Troponin I serum assay - stat, CK-MB and total CK q 8h x 3, then q 12 until return toward normal.
b) Electrocardiogram - daily x 2 d and day prior to discharge or with clinical change suggesting recurrent ischemia. With reperfusion Rx, at end of therapy and repeat in 4-6 hours and then as above.

5) Echocardiography - Echo can provide prognostic information in MI patients. Whether that information is clinically useful depends on the setting. Therapy should not be delayed to obtain an echocardiogram. If therapy or subsequent diagnostic efforts would be altered by the information provided by echo (LV function, size localization and severity of regional wall motion abnormalities, regional thinning of myocardium, presence of valvular abnormalities) then echo should be performed acutely. Additional diagnostic information required: persistent CP with normal ECG, r/o pericarditis, or r/o aortic dissection (consider TEE) - murmur of MR or potentially significant aortic stenosis - non-localized MI (LBBB, other)

6) Acute coronary angiography - initial reperfusion strategy with direct angioplasty or acute CABG as indicated by coronary anatomy and LV function.

7) Right heart catheterization - for complicated MI (hypotension, oliguria, CHF, respiratory insufficiency).

II. Initial Therapy

A. Aspirin: All patients should receive regular ASA 325 mg immediately (have patient chew dose) as soon as possible unless a definite contraindication is present (evidence of ongoing life-threatening hemorrhage or a clear history of severe hypersensitivity to ASA). The initial ASA should be chewed and given even if the patient reports daily use. ASA should be continued daily (81 to 325 mg) thereafter unless coronary artery disease is excluded and primary prevention is not indicated or a contraindication to ASA develops. Meta-analysis of the randomized placebo controlled studies suggests that ASA reduces the risk of death by 25% in AMI. Patients unable to take ASA because of a history of true hypersensitivity or recent significant ASA induced GI bleeding may be started on clopidigrel 300 mg first dose, followed by 75 mg qd as a substitute. It takes up to 3 days for the maximal antiplatelet effect if a loading dose is not used.

B. Intravenous Heparin or Low Molecular Weight Heparin should be started as soon as a diagnosis of myocardial infarction is suspected. The initial dose of unfractionated heparin is 71 units/kg by IV bolus followed by a constant infusion of 14 units/kg/hr maintaining the activated partial thromboplastin time at 1.8 to 2.5 control (see Heparin Protocol). Alternately Enoxaparin in a dose of 1 mg/kg q12h SQ may be given. Heparin should be continued from 2-4 days or until revascularization is performed. Patients are at increased risk for recurrent ischemia in the first 24 hours that heparin is discontinued. Randomized studies demonstrate that heparin reduces the risk of death and recurrent myocardial infarction. In the ESSENCE Trial, enoxaparin was more effective than unfractionated heparin in preventing coronary events in patients with unstable angina and non-Q wave MI. Indicated for all patients without absolute contraindications whether undergoing thrombolytics therapy (see thrombolytic protocols for dosing), direct catheterization, conservative treatment, or medical management for unstable angina.
C. **Beta blockers** is indicated in all patients without contraindications. The intravenous form should be used to initiate therapy. In the presence of risk factors such as existing pulmonary disease, LV dysfunction, bradycardia, initial selection should favor a short acting agent such as propranolol, metoprolol, or esmolol. A history of moderate COPD or asthma should prompt a trial of a short-acting agent at a reduced dose rather that complete avoidance of beta-blocker therapy. Contraindications are cardiogenic shock, hypotension (SBP < 80 mmHg), decompensated heart failure, symptomatic bradycardia, 2 or 3rd degree heart block without a pacemaker. Diabetes and peripheral vascular disease are not contraindications. The target resting heart rate for beta blockade is 50 to 60 beats per minute. **Beta blockers reduce the risk of death and recurrent MI.**

Intravenous - metoprolol 5 mg IV x 3 (2-5 minute intervals) followed by 100 mg PO BID. - *benefit to all acute MI patients including "high risk" patients with large infarcts, LV dysfunction, diabetes, or older age.*

Oral - metoprolol 50-100 mg PO BID or atenolol 100 mg qd mg qd) immediately (30-60 min) following IV infusion and thereafter. -contraindications as above. - *all patients without contraindications should be treated with beta blocker therapy as demonstrated in 64 post MI trials.*

D. Direct Angioplasty - preferred reperfusion therapy.

Acute catheterization followed by direct angioplasty without antecedent thrombolytic therapy is the preferred therapy for acute myocardial infarction at UCLA. Direct catheterization should be strongly considered in all patients presenting < 24 hours after the onset of symptoms regardless of whether symptoms are ongoing, if Q wave have developed, or ST segment elevation has resolved. Direct catheterization should be considered essential in the following circumstances:

1) Patients with contraindications to thrombolysis
2) Need for rapid, 95% successful reperfusion (less than 1-2 hrs. symptoms with large infarct)
3) Cardiogenic shock with single vessel disease or single vessel target.

- *studies have suggested more rapid and more complete recovery of wall motion with direct PTCA, less post MI ischemia, shorter hospitalization, and less need for further revascularization procedures. Mortality is significantly reduced acute MI patients especially those at high risk (anterior MI, sinus tachycardia HR >100, and elderly age >70) with primary angioplasty compared to thrombolytic agents.*

The use of glycoprotein IIb/IIIa (abciximab, eptifibitide, or tirofiban) should be strongly considered as an adjunct to direct angioplasty. *In EPIC and CAPTURE Trials the acute complication, mortality, and reintervention rates were significantly reduced.* Direct coronary stenting should also be strongly considered to increase the initial success rate and decrease subsequent restenosis. Patients post stenting should receive aspirin indefinitely and clopidigrel 75 mg qd for 4 weeks. (see UCLA Glycoprotein IIb/IIIa receptor antagonist guideline)

E. Thrombolytic Therapy - *Risk of failure to reperfuse (30%) toxicity (5%) should be balanced with benefit.*

1) Clear indications - symptoms less than 12 hours and EKG showing ST elevation in 2 or more leads or LBBB, not known to pre-exist
2) Indications present but smaller benefit - symptoms more than 6 hours but less than 12 hours with Q wave development.
3) Not indicated - ST depression, symptoms longer than 12 hours (except where clear evidence of ongoing ischemic injury by continued pain, ST elevation) *Coronary angiography and direct PTCA should be considered as alternative therapy*
4) Contra-Indications

**Relative:** - prior MI with LV dysfunction, moderate-severe CHF, remote GI bleeding or bleeding diathesis, hypertension out of control in elderly, or pregnancy (direct angioplasty preferred)

**Absolute:** - cardiogenic shock, active bleeding or recent (<1 week) surgery, Hx CNS hemorrhage, tumor, aortic
dissection, acute pericarditis

5) Agents

a) Streptokinase - 1.5 million units over 30-60 minutes (see protocol). effective with fresh clot, small clot burden. Failure to lyse about 30-40%. Reocclusion (8%). Time to lysis is slower than rt-PA, 60-90 min. Costs less but less survival benefit than front loaded rt-PA

b) Tissue plasminogen activator - Front-loaded, weight adjusted regimen (see protocol) - patients who have received Streptokinase in last 12 months or might be expected to have high ASO levels should receive TPA. more effective on older clot, faster lysis (45-60 min).- essential to use when substantial myocardial salvage possible (less than 2 hours, no Q wave, continued pain) when time to lysis more critical.- survival benefit over streptokinase demonstrated for < 4-6 hours, anterior infarction, age <75. Must use asa and heparin in effective doses.

F. Acute CABG - clear indication in cardiogenic shock or low output syndrome with left main or severed multivessel disease. Support with IABP while awaiting OR. - potential benefit of modified reperfusion improving myocardial salvage. No randomized clinical trial evidence as yet.

G. Nitroglycerin - Indicated for the symptomatic control of ischemia and to prevent vasospasm post direct angioplasty. No clinical trial data to show mortality reduction however, no evidence of harm.

1) IV NTG - minimum effective dose approx. 30-50 mcg/min. Maximum approximately 200 mcg/min. Response to recurrent ischemia must include re-bolus with SL NTG; increase infusion rate for maintenance. Cautions - Hypotension, RV infarct, inferior MI with bradycardia.

2) Non-parenteral - PO or topical nitrates. Indicated for the symptomatic control of angina. No benefit to topical or oral nitrates started or continued 24 hours after infarction compared to placebo in ISIS-4 and GISSI-3.

H. Oxygen - indicated for treatment of hypoxia with low flow for 24-48 hrs Consider selective use for pulse oximetry< 92%. - mechanism of benefit remains unclear. Required duration, net benefit not established.

I. Analgesia - unknown benefit when pain is not severe or accompanied by evidence of excessive autonomic time. Morphine IV is a drug of choice. Cautions with regards to hypotension and respiratory depression.

J. Calcium channel blockers - no acute indications other than treatment of post-infarction angina not responsive to heparin, nitroglycerin, beta blockade, and intra-aortic balloon counterpulsation or SVT in patient not tolerate or responsive to digoxin and/or beta blockers; Over 20 randomized clinical trials have demonstrated no benefit and possibly increased mortality with the use of calcium channel blockers during and post MI.

K. Antiarrhythmic drugs - indications include hemodynamically unstable non-sustained ventricular tachycardia, sustained VT. Initial agents of choice are either amiodarone or lidocaine (1mg/kg bolus followed in 10-15 min by 0.5 mg/kg bolus with 2 mg/min drip established after 1st bolus). Need to closely follow levels and monitor for signs of toxicity. Prophylactic lidocaine is not indicated. Prophylactic lidocaine has been shown to increase risk of asystole and increase MI mortality.

III. Sub-acute Therapy

A. Monitoring - electrocardiographic monitoring for arrhythmias and silent ischemia should be continued for 48-72 hours in uncomplicated MI.
Patients with uncomplicated MI who have undergone direct stenting without further ischemic risk may be discharged 48-72 hours. Patients treated conservatively can be discharged between 3-5 days after further risk stratification with stress testing or angiography.

B. Continuation of Acute Therapy

1) **Aspirin** - dose 81-325 mg po qd should be continued long term in all patients without contraindications. Patients in whom such contraindications exist may be treated with clopidigrel 75 mg po qd or considered for anticoagulation with warfarin to INR 2.0 - 3.5. Post stent patients should receive clopidigrel for 2-4 weeks in addition to long term aspirin.

2) Heparin - indications not demonstrated beyond 48 hours except for atrial fibrillation or LV thrombus - **Consider long term (3 mos) SQ heparin for large anterior MI or anticoagulation with warfarin.**

3) **Beta blockers** – all patients without contraindications, with benefits long term. Diabetes, peripheral vascular disease, mild to moderate asthma/COPD patients have mortality reductions with beta blockers. Patient with LV dysfunction and Class IV heart failure have mortality reductions. For patients with cardiogenic shock, hypotension, or decompensated heart failure delay beta blocker therapy until patient stabilizes. **Principal benefits are in diminishing pathologic remodeling in addition to prevention of sudden death and recurrent infarction. Treatment with an ACE inhibitor was additive and perhaps synergistic to beta blocker therapy in the 9 large post MI ACE inhibitor trials.**

4) Nitrates - no indications past 48-72 hrs except with continued ischemia (where revascularization is the preferred treatment) or the symptomatic control of stable effort induce angina.

5) Oxygen - not indicated after 1-2 days except in the presence of hypoxia, CHF, continued ischemia.

C. Subacute Therapy

1) **ACE inhibitors** - All MI patients without contraindications should be started on ACE inhibitors within 12-24 hours of AMI onset and treated long term. Patients with acute myocardial infarction have improved early survival and less heart failure when treated with ACE. This is true even if the blood pressure and ejection fraction are normal. All post CABG, post PTCA, post unstable angina, post MI, stable CAD, PVD, CVD, and diabetic patients should receive an ACE inhibitor, unless a specific contraindication is documented. Renal insufficiency in the setting of AMI is a double indication for ACE inhibitors. Start at low dose and titrate to target doses. Contraindications include history of angioedema, cardiogenic shock, hypotension, hyperkalemia, and pregnancy. In cardiogenic shock and hypotension delay ACE inhibitor treatment until the patient stabilizes. Angiotensin receptor antagonists should be used in ACEI intolerant patients. **Interchangeability of ACE inhibitors demonstrated. Survival benefit was shown in ISIS-4 and GISSI-4 for all MI patients starting ACE inhibitor therapy at 12-24 hours (benefit within 48 hrs, so start early Rx). The HOPE trial demonstrated that in patients with CAD, CVD, PVD or diabetes the use of an ACE inhibitor was associated with a reduction in cardiovascular events, cardiovascular mortality, and all cause mortality. This benefit was seen in patients without hypertension and with normal left ventricular ejection fractions. Long term treatment with ACE inhibitors is thus indicated in any patient with documented atherosclerosis.**

2) **Statins:** These agents have potent vascular and cardiac protective effects. These agents are indicated in all patients with atherosclerosis. Statins reduce vascular inflammation and stabilize the vulnerable atherosclerotic plaque, thereby markedly reducing the risk of vascular events. These benefits are seen in patients with cholesterol and LDL levels in the low, normal, and high range. Clinical trials have shown mortality reduction in patients with baseline LDL levels of 70 mg/dl and above. Initiation of statin therapy in patients with documented atherosclerosis results in a reduction in myocardial infarction, unstable angina, stroke, need for revascularization, hospitalization,
and all cause mortality compared to patients treated with diet alone. This is true regardless of whether the patient has undergone CABG, PTCA, or is being treated medically.

These benefits are seen early such that patients should be started on therapy prior to hospital discharge. Early benefits (within 8 - 16 weeks) can be seen in patients presenting with acute coronary syndromes when started on immediate statin treatment as shown in MIRACL. Initiation on admission facilitates compliance.

The starting dose of statin should be a dose estimated to achieve at least a LDL < 100mg/dl based on the baseline lipid panel. In patients where the baseline LDL is known, the use of the UCLA LDL Treatment to Goal Guide is recommended. In patients where the baseline LDL is pending or not known, empiric doses may be used: pravastatin 40 mg qhs, simvastatin 20-40 mg qhs, atorvastatin 10-20 mg qd. If the statin is started on admission an empiric dose may used with adjustment of dose when the lipid panel results are available, if necessary. Contraindications include pregnancy or serious underlying liver disease. Obtain baseline LFTs (but remember AMI can raise LFTs. If there is not underlying liver disease, statins can still be safely initiated in the setting of LFTs increased secondary to AMI).

3) Warfarin – indicated for atrial fibrillation and LV thrombus post myocardial infarction. Warfarin has been shown to reduce post MI mortality in randomized trials in patients not taking ASA. Consider warfarin for patients post MI unable to take aspirin. Combination therapy with low intensity warfarin anticoagulation in combination with ASA failed to demonstrate any advantage. Warfarin reduces the risk of embolization after anterior MI.

3) Antiarrhythmic agents - type I antiarrhythmic agents have been shown to substantially increase the risk of sudden death and overall mortality in patients post myocardial infarction. These agents should be avoided in all patients post MI except those with ICDs or in whom the risk benefit ratio has been carefully considered. The same is true for the type III agent sotalol. Amiodarone should be considered the only safe antiarrhythmic agent post MI. Compared to placebo amiodarone was neutral with respect to sudden death and mortality in post MI trials in patients at risk by Holter or LVEF criteria.

4) Rehabilitation in hospital - Ambulation should begin by day 2-3 in uncomplicated MI and patient should be walking ad lib in corridor prior to discharge.

IV. Risk Assessment

A. Residual Ischemia/Extent of Coronary Disease.
Can often omit stress testing if patient has undergone direct catheterization.

1) Stress echo - patients with uncomplicated MI in whom stress test can be performed and in whom information regarding residual ischemia would alter therapy or mode of follow up. Test at 3-5 days with modified Sheffield stress.
   - positive test as determined by unequivocal angina, diagnostic ST-T abnormalities, new or substantial worsening of regional wall motion or fall in ejection fraction (any one finding). Consider coronary angiography and some form of revascularization.

2) Dobutamine echo - for individuals who cannot perform treadmill due to noncardiac causes.

3) Stress sestamibi is an appropriate substitute with better determination of residual viability in infarct zone but less prognostic information about LV function or valve abnormalities. - should be used when patient is difficult to echo. Positive if substantial redistribution in MI zone or non infarct area.

4) Disopyramide (perstantine) or adenosine sestamibi - use for individuals who cannot perform stress due to non-cardiac causes. (Cardiac limitation suggests need for coronary angiography) - positive as above.
B. Ventricular function - ventricular function should be measured in all patients who have sustained a myocardial infarction: prognostically important information, particularly with regard to arrhythmic death risk and risk of developing heart failure and identifies patients with definite long term ACE inhibitor indication. With prior acute echo or left ventriculogram measurement not indicated unless new diagnostic question has arisen (new evidence of CHF, ischemia).

Echo is method of choice. If coronary angiogram is done, LV gram will substitute for echo.

C. Arrhythmic risk - routine arrhythmia testing (e.g. Holter, signal averaged ECG, electrophysiology testing) is not recommended following uncomplicated acute MI if LVEF > 0.35. In patients with LVEF < 0.35, if cardiac monitoring or 24 Holter demonstrate NSVT more than 24 hours after MI onset, EP study recommended. If patient inducible, ICD placement reduces mortality. In post AMI setting beta-adrenergic blockers and ACE inhibitors have been shown to reduce sudden death post MI, and should be considered for all patients regardless of arrhythmia risk (see above). Type I antiarrhythmic agents and sotolol increase the risk of sudden death and overall mortality and should be avoided. Amiodarone can be used safely post MI but does not improve outcome over placebo. Class I antiarrhythmic drugs to suppress asymptomatic ambient ectopy increase mortality and are contraindicated.

D. Coronary Angiography - See below.

V. Revascularization

Within the first 24 hours reperfusion with direct angioplasty and/or stenting is indicated. Beyond 24 hours or in post thrombolytic treated patients, data suggests that in the absence of evidence of post MI ischemia, revascularization is not necessary. However, poor LV function may describe a different risk set where sensitivity of stress-imaging may be less (because of severe pre-existing wall motion abnormalities or extensive flow deficit). The underlying extent of coronary artery disease may be a more important determinant of prognosis than the presence of ischemia.

Coronary angiography in patients with large infarcts and LVEF <40% may disclose potentially unstable lesions or anatomy best treated with CABG (or occasionally by PTCA).

A. PTCA/Stenting

In post-lytic patients, with residual ischemia, PTCA improves rate of LV function improvement, decreases anginal incidence and has small but definite effect on recurrent MI and mortality in patients with history of previous myocardial infarction.

Restenosis rates approaching 50% and acute closure rates of 5-8% with PTCA particularly with complex lesions with residual thrombus should be considered in decision. Coronary stents markedly lower both the risk of acute complications and risk of restenosis. Glycoprotein RA reduce the risk of death/MI.

Multivessel angioplasty, early post-MI, is an option but has not been fully studied in terms of mortality or infarct prevention.

B. CABG - multivessel disease or proximal LAD disease with residual viability are indications for CABG in patients with post-MI ischemia. Patients with LVEF < 40% and multivessel disease without provokable ischemia should be considered for CABG, based on studies suggesting improved 5 and 10 year mortality in this group.

VI. Pre-Discharge and Post-Hospital Care
Atherosclerosis is a progressive disease. While the short-term prognosis may be improved with medical management and revascularization strategies, the underlying atherosclerotic disease process must be addressed to improve long term patient outcome. Overwhelming scientific evidence demonstrates that treatment alters the natural history of this disease, improves clinical outcomes, and prolongs survival. The goal, whether it be during hospitalization or an outpatient visit for any reason, in a patient with coronary artery disease, cerebral vascular disease, or peripheral vascular disease is to ensure the initiation and maintenance of clinical trial evidence based therapies.

Therapies that have definitively been demonstrated to lower the risk of subsequent mortality in patients with demonstrated atherosclerosis include aspirin, cholesterol lowering medications, angiotensin converting enzyme inhibitors, exercise, and smoking cessation. Medications that lower the risk of myocardial infarction in patients with coronary artery disease as well as prolong survival in patients after myocardial infarction and patients with heart failure include beta blockers. Despite the clinical trial evidence supporting their use, these survival enhancing therapies are underutilized when guided by conventional care.

**Cardiovascular Hospitalization Atherosclerosis Management Program: CHAMP**

**Treatment Algorithm**

Combination therapy targeting the underlying atherosclerotic disease process can markedly improve clinical outcome in patients with atherosclerosis, whereas failure to employ these therapies increases patient mortality. Compliance and treatment utilization can be enhanced by employing secondary prevention measures prior to hospital discharge. Patients should not be discharged from the without initiation of definitive atherosclerosis treatment, unless contraindications exist and are documented.

In patients with coronary, cerebral, or peripheral atherosclerosis:

Prior to hospital admission (nonfasting) cardiovascular lipid panel

- Prescribe aspirin, statin, ACE inhibitor, beta blocker, exercise, and dietary counseling
- Discontinue calcium blocker
- Document smoking status and advice to stop smoking

Six week follow-up

- Obtain fasting cardiovascular lipid panel and LFTs in 6 weeks
- Adjust statin dose to achieve LDL cholesterol ≤ 100 mg/dl
- Recheck in 6 months, review medications on each subsequent visit
- Reinforce adherence to the atherosclerosis treatment regimen

**Medical Regimen for Patients with Atherosclerosis**

**Aspirin**: Antiplatelet therapy reduces the risk of vascular events in patients with atherosclerosis. Patients should continue on ASA, 81 mg to 325 mg per day indefinitely after discharge. Contraindications include true aspirin allergy with nasal polyposis and active bleeding. In patients with coronary artery disease, ASA lowers the risk of myocardial infarction, unstable angina, need for revascularization, and death. Pooling data from the four largest trials suggests a 48% reduction in the risk of myocardial infarction and a 51% reduction in the risk of death. This benefit continues beyond ten years. Patients that have contraindications or intolerance to ASA should be treated with clopidogrel 75 mg qd. Patients with a recurrent event despite ASA should also be considered for clopidogrel treatment.

**Statins**: Clinical trials have shown mortality reduction in patients with baseline LDL levels of 70 mg/dl and above. Initiation of statin therapy in patients with documented atherosclerosis results in a reduction in myocardial infarction, unstable angina, stroke, need for revascularization, hospitalization, and all cause mortality compared to patients treated with diet alone. This is true regardless of whether the patient has undergone CABG, PTCA, or is
being treated medically.

These benefits are seen early such that patients should be started on therapy prior to hospital discharge. Early benefits (within 8 - 16 weeks) can be seen in patients presenting with acute coronary syndromes when started on immediate statin treatment as shown in MIRACL. The starting dose of statin should be a dose estimated to achieve at least a LDL < 100mg/dl based on the baseline lipid panel. In patients where the baseline LDL is known, the use of the UCLA LDL Treatment to Goal Guide is recommended (see last page). In patients where the baseline LDL is pending or not known, empiric doses may be used: pravastatin 40 mg qhs, simvastatin 20-40 mg qhs, atorvastatin 10-20 mg qd. Patients who fail to achieve target lipid levels (LDL < 100 mg/dl) at 6 weeks after initiation of therapy should have their dose increased or an additional agent (niacin or cholesterol binding resin) added.

The target lipid levels in patients with coronary artery disease are a total serum cholesterol < 160 mg/dl, LDL cholesterol < 100 mg/dl and a HDL cholesterol > 45 mg/dl. For patients with a baseline LDL < 100 mg/dl, aim for a target level < 70 mg/dl (ongoing trials are evaluating this further). The benefits of statins are seen in men and women, older and younger patients, diabetics and non-diabetics. Contraindications include pregnancy or serious underlying liver disease. Obtain baseline LFTs.

Patients with coronary artery disease will live longer when treated with a HMG CoA Reductase Inhibitor. In the 4S trial there was a 34% risk reduction in major cardiac events, a 42% risk reduction in cardiovascular mortality and a 30% reduction in all cause mortality associated with statin treatment. The LIPID trial demonstrated that even patients with "low or normal" levels of total cholesterol and LDL cholesterol (LDL 70-170 mg/dl) have mortality reduction with statin treatment. Patients should be educated that these medications are for the treatment of atherosclerosis, not because the patient has “failed” dietary treatment and that use of these medications lowers the risk of recurrent events, need for revascularization, hospitalizations, strokes, and mortality.

ACE Inhibitors: These agents have potent vascular and cardiac protective effects. These agents are indicated in all patients with atherosclerosis. Patients with coronary, peripheral, cerebral vascular disease, and diabetes have reduced risk of MI, stroke, heart failure, and death when treated with an ACE inhibitor. This is true even if the blood pressure and ejection fraction are normal. All post CABG, post PTCA, post unstable angina, post MI, stable CAD, PVD, CVD, and diabetic patients should receive an ACE inhibitor, unless a specific contraindication is documented. Patients with acute myocardial infarction have improved early survival and less heart failure when treated with ACE inhibitors. All MI patients without contraindications should be started on ACE inhibitors within 12-24 hours and treated long term. Patients with left ventricular dysfunction should be started and maintained on an ACE inhibitor indefinitely. Renal insufficiency in the setting of CAD or diabetes is a double indication for ACE inhibitors. The benefit of ACE inhibitors is independent of blood pressure status. Use target doses. Contraindications include history of angioedema, cardiogenic shock, hyperkalemia, and pregnancy. Angiotensin receptor antagonists should be used in ACEI intolerant patients.

The HOPE trial demonstrated that in patients with CAD, CVD, PVD or diabetes the use of an ACE inhibitor was associated with a reduction in cardiovascular events, cardiovascular mortality, and all cause mortality. This benefit was seen in patients without hypertension and with normal left ventricular ejection fractions. Long term treatment with ACE inhibitors is thus indicated in any patient with documented atherosclerosis.

Beta Blockers: These agents should be considered in all patients with atherosclerosis, since they reduce the risk of myocardial infarction and make it more likely that a patient will survive an infarction. These agents should be considered first line agents for the symptomatic control of angina. In addition these agents prolong survival in patients with previous myocardial infarction as well as reduce the risk of unstable angina in patients with coronary artery disease. These agents also attenuate the remodeling process post myocardial infarction and reduce the risk of developing heart failure. In a patient with coronary artery disease and hypertension, beta blockers are an excellent first line agent. The duration of benefit with therapy extend indefinitely. Use target doses as clinically
tolerated. Contraindications include symptomatic bradycardia, 2nd/3rd degree AV block without pacemaker, cardiogenic shock, acutely decompensated heart failure, severe asthma or COPD, diabetic with recurrent life threatening hypoglycemic episodes. Please note that diabetes, peripheral vascular disease, mild/moderate asthma or COPD, asymptomatic bradycardia, and heart failure are not contraindications and should not preclude the use of beta blockers.

Nitrates: These agents should be considered second line agents after beta blockers for the symptomatic control of angina. There is no long term data that nitrates improve prognosis in patients with coronary artery disease so that their use is dictated solely for symptom relief. Patients who are not having symptomatic angina do not need to be routinely discharged on long acting nitrates. When long acting nitrates are indicated, a daily nitrate free interval is necessary to decrease tolerance. Patient should be discharged with prn SL nitroglycerine as well as instructions as to its use.

Calcium channel blockers: These agents decrease chest pain but do not decrease the risk of a cardiac event or improve outcome. They should in general not be prescribed. Calcium blockers should be considered for palliative use only in patients who have failed to respond to all other therapy. In patients with coronary artery disease post myocardial infarction, the risk of a subsequent cardiac event and mortality is not reduced and may in fact be increased with calcium channel blockers. In patients with angina there is an increased risk of coronary events with calcium blockers as compared to angina control with beta blockers. In patients with coronary artery disease and hypertension these agents should be reserved for patients who are intolerant of or fail to have their blood pressure controlled with beta blockers, ACE inhibitors, angiotensin receptor blockers, diuretics, and their combination.

Antiarrhythmic agents: Type I antiarrhythmic agents markedly increase the risk of sudden death in patients with coronary artery disease. This is because all type I antiarrhythmic agents markedly lower the fibrillation threshold of ischemic myocardium. Even when used to maintain sinus rhythm for atrial fibrillation or when guided by EPS or Holter monitoring, these agents increase the risk of overall mortality for CAD patients. These agents should be avoided in all patients with CAD except those with ICDs or in whom the risk benefit ratio has been carefully considered. Amiodarone should be considered the only safe antiarrhythmic agent in patients with CAD. Compared to placebo amiodarone was neutral with respect to sudden death and mortality in post MI trials.

**Exercise:** Patients should receive specific instructions for a minimum of 3 - 5 x week aerobic exercise program. Exercise increases HDL, reduces the risk of myocardial infarction, and improves survival in patients with coronary artery disease. Either a home based program or supervised cardiac rehabilitation can be recommended. This is an essential component of the management of patients with coronary artery disease and is highly effective in preventing subsequent cardiac events. Patients should be offered referral to a cardiac rehabilitation program in their area. In addition to a specific exercise prescription patients require instructions on activities that are permissible and those that should be avoided (e.g. heavy lifting).

**Smoking Cessation:** Particular attention should be paid to smoking cessation. Patients who continue to smoke after presenting with unstable angina have 5.4 times the risk of death from all causes compared to patients who stop smoking. Patients should be offered intensive smoking cessation intervention during hospitalization. This should include both physician and nurse counseling focusing on relapse prevention. Patients should receive a relapse prevention manual and be given written information about the outpatient behavioral modification programs available and the option of nicotine replacement therapy and/or buproprion (Zyban). The recommendation for smoking cessation should be clearly documented in the medical record.

**Diet:** Although standard dietary intervention alone has not be shown to be beneficial, there may still be benefit when diet is used in combination with exercise and cholesterol lowering medications in patients with coronary artery disease. Patients and family members, if available, should receive counseling on the National Cholesterol
Education Program Step 2 Diet during the hospitalization. Information on the outpatient dietary modification programs available should be provided. Supplementation with Omega 3 fatty acids have lowered the risk of recurrent myocardial infarction. Discourage use of very low fat diets.

**Patient Education:** The patient and his or her family member or advocate should be instructed regarding the use of medications and monitoring of symptoms. The purpose, dose, and major side effects of each medication prescribed should be explained. Written medication sheets and a medication schedule should be provided to each patient (available on the UCLA Quality Management Services web site). The warning signs of a heart attack should be discussed with each patient and their immediate plan of action reviewed, including call 911. A patient education sheet should be provided. Patients should be instructed to contact their primary care physician or cardiologist if they have a non-acute change in symptom pattern and discuss whether changes in the management plan are warranted. *Patient delays in seeking medical attention are a major contributor to diminished benefit with reperfusion therapy. Detailed patient education has been demonstrated to reduce the time to treatment in acute myocardial infarction.*

**Follow-up:** Continuation of the therapies targeting the underlying athero sclerotic disease process markedly improve clinical outcome in patients with atherosclerosis. *The continued use of the beneficial therapies prescribed should be strongly reinforced during patient follow-up. The medications the patient is taking should be reviewed on each visit. If one or more of the survival enhancing medications is not prescribed, the specific contraindication or intolerance should be clearly documented in the medical record.*

After initial statin treatment, a fasting lipid panel should be obtained at 6 weeks to evaluate whether target lipid levels have been achieved and guide cholesterol lowering medication dosing adjustments. Obtain LFTs at 6 weeks and with any dose escalation. CPK need only be checked if muscular symptoms arise. Document LDL < 100 mg/dl on biannual or annual basis. Document BP and Diabetes control. The need for daily aerobic exercise should be reinforced and the patient's progress monitored. Stress testing does not appear to be indicated in the routine follow-up of patients with coronary artery disease and should, in general, be performed for specific reasons such as a change in symptoms or in following patients with silent ischemia.

**Medical Record**

The patient's medical record at the time of hospital discharge should summarize cardiac events, results of diagnostic testing, current symptoms, and the discharge medical regimen. The major instructions, postdischarge follow-up plan, follow-up physician, and the patient's understanding and plan for adherence to the recommendations should be documented in the medical record. The comprehensive care plan for secondary prevention should be summarized. The primary care physician that will be providing follow-up care should be contacted and the treatment plan discussed.

**Document:**

Current medications (if ASA, beta blocker, ACE inhibitor, or statin not currently prescribed, document contraindication, intolerance, or alternative medication utilized)

LDL and HDL (from within last 1 year)

Current blood pressure

Weight

If history of heart failure, LVEF

If diabetes, HbA1c from with within last 1 year, annual ophthalmology retinal exam, foot exam and care

If history of smoking, current status and advice to quit smoking