ACC/AHA Pocket Guideline

**Based on the ACC/AHA Guidelines
for the Management of Patients
With ST-Elevation Myocardial Infarction**

**Management
of Patients With
ST-Elevation
Myocardial
Infarction**

July 2004

Management of Patients With
ST-Elevation Myocardial Infarction

July 2004

ACC/AHA Writing Committee

Elliott M. Antman, MD, FACC, FAHA, Chair
Daniel T. Anbe, MD, FACC, FAHA
Paul Wayne Armstrong, MD, FACC, FAHA
Eric R. Bates, MD, FACC, FAHA
Lee A. Green, MD, MPH
Mary Hand, MSPH, RN, FAHA
Judith S. Hochman, MD, FACC, FAHA
Harlan M. Krumholz, MD, FACC, FAHA
Frederick G. Kushner, MD, FACC, FAHA
Gervasio A. Lamas, MD, FACC
Charles J. Mullany, MB, MS, FACC
Joseph P. Ornato, MD, FACC, FAHA
David L. Pearle, MD, FACC, FAHA
Michael A. Sloan, MD, FACC
Sidney C. Smith, Jr, MD, FACC, FAHA

Contents

Management
Before STEMI

Onset of STEMI

Hospital Management

Secondary Prevention

I. Introduction

The full text of the guidelines is available on the World Wide Web sites of the American College of Cardiology (*www.acc.org*) and the American Heart Association (*www.americanheart.org*). The executive summary is published in the August 4, 2004 issue of the *Journal of the American College of Cardiology* and the August 3, 2004 issue of *Circulation*.

This pocket guide provides rapid prompts for appropriate patient management, which is outlined in much greater detail in the full-text guidelines. It is not intended as a replacement for understanding the caveats and rationales that are stated carefully in the full-text guidelines. Users should consult the full-text document for more information.

Scope of the Guidelines

The purpose of these guidelines is to focus on the numerous advances in the diagnosis and management of patients with ST-elevation myocardial infarction (STEMI) since 1999. It is recognized that there are areas of overlap among these guidelines on patients with STEMI, the guidelines on patients with unstable angina/non-STEMI, and other guidelines. The committee has handled this overlap by reiterating important concepts and recommendations in the STEMI guidelines and by providing cross-references to other guidelines.
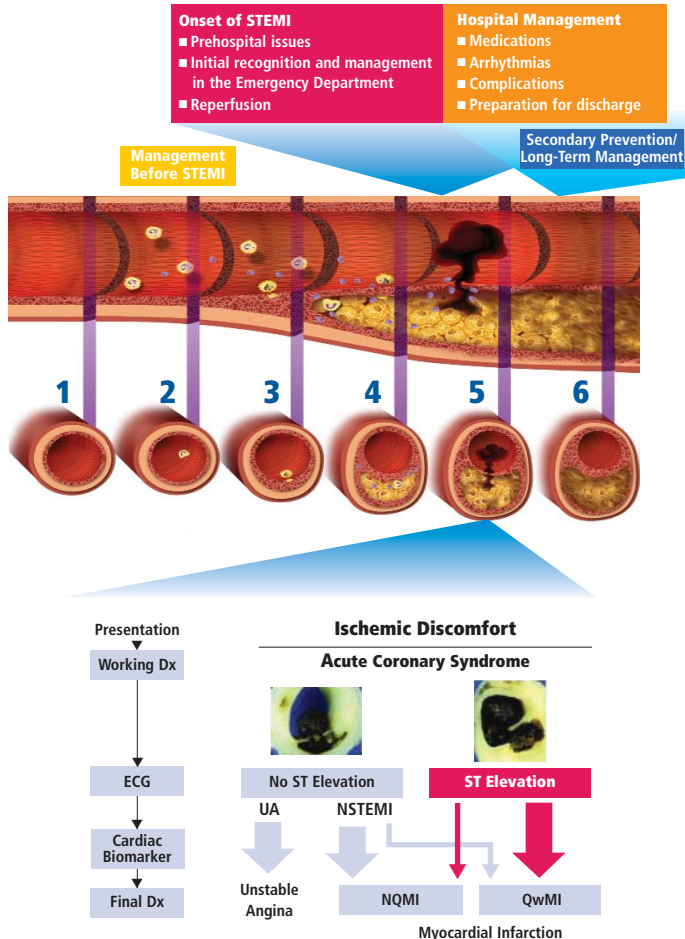
Table 1. Applying Classification of Recommendations and Level of Evidence in ACC/AHA Format

SIZE OF TREATMENT EFFECT →

ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT

	CLASS I *Benefit >>> Risk* **Procedure/Treatment SHOULD be performed/ administered**	CLASS IIa *Benefit >> Risk* *Additional studies with focused objectives needed* **IT IS REASONABLE** to perform procedure/administer treatment	CLASS IIb *Benefit ≥ Risk* *Additional studies with broad objectives needed; additional registry data would be helpful* **Procedure/Treatment MAY BE CONSIDERED**	CLASS III *Risk ≥ Benefit* *No additional studies needed* **Procedure/Treatment should NOT be performed/administered SINCE IT IS NOT HELPFUL AND MAY BE HARMFUL**
LEVEL A Multiple (3-5) population risk strata evaluated* General consistency of direction and magnitude of effect	■ Recommendation that procedure or treatment is useful/effective ■ Sufficient evidence from multiple randomized trials or meta-analyses	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Sufficient evidence from multiple randomized trials or meta-analyses
LEVEL B Limited (2-3) population risk strata evaluated*	■ Recommendation that procedure or treatment is useful/effective ■ Limited evidence from single randomized trial or nonrandomized studies	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Limited evidence from single randomized trial or nonrandomized studies
LEVEL C Very limited (1-2) population risk strata evaluated*	■ Recommendation that procedure or treatment is useful/effective ■ Only expert opinion, case studies, or standard-of-care	■ Recommendation in favor of treatment or procedure being useful/effective ■ Only diverging expert opinion, case studies, or standard-of-care	■ Recommendation's usefulness/efficacy less well established ■ Only diverging expert opinion, case studies, or standard-of-care	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Only expert opinion, case studies, or standard-of-care
Suggested phrases for writing recommendations	should is recommended is indicated is useful/effective/beneficial	is reasonable can be useful/effective/beneficial is probably recommended or indicated	may/might be considered may/might be reasonable usefulness/effectiveness is unknown/unclear/uncertain or not well established	is not recommended is not indicated should not is not useful/effective/beneficial may be harmful

*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as gender, age, history of diabetes, history of prior MI, history of heart failure, and prior aspirin use.

Figure 1. Acute Coronary Syndromes

Onset of STEMI
- Prehospital issues
- Initial recognition and management in the Emergency Department
- Reperfusion

Hospital Management
- Medications
- Arrhythmias
- Complications
- Preparation for discharge

Secondary Prevention/Long-Term Management

Management Before STEMI

1 2 3 4 5 6

Presentation → Working Dx → ECG → Cardiac Biomarker → Final Dx

Ischemic Discomfort

Acute Coronary Syndrome

No ST Elevation → UA / NSTEMI
ST Elevation

Unstable Angina / NQMI / QwMI

Myocardial Infarction

The top half of the figure illustrates the chronology of the interface between the patient and the clinician through the progression of plaque formation and the onset and complications of STEMI, along with relevant management considerations at each stage.

Following disruption of a vulnerable or high-risk plaque, patients experience ischemic discomfort resulting from a reduction of flow through the affected epicardial coronary artery. Of patients with ST-segment elevation, most (large red arrow in bottom panel) ultimately develop a Q-wave MI (QwMI), while a few (small red arrow) develop a non-Q-wave MI (NQMI).

STEMI, ST-elevation myocardial infarction; **Dx**, diagnosis; **NQMI**, non–Q-wave myocardial infarction; **QwMI**, Q-wave myocardial infarction.

Modified with permission from Libby. Circulation 104:365,2001, Hamm et al. The Lancet 2001;358:1533-1538 and Davies. Heart 2000;83:361-366 with permission from the BMJ Publishing Group.

Pages in the Pocket Guide are color-coded to correspond to the chronological interface of the clinician with the patient. Pages with yellow tabs refer to Management Before STEMI, pages with red tabs refer to the Onset of STEMI, pages with orange tabs refer to Hospital Management, and pages with blue tabs refer to Secondary Prevention/Long-Term Management.

Management Before STEMI

Onset of STEMI

Hospital Management

Secondary Prevention

II. Management Before STEMI

A. Recommendations for Identification of Patients at Risk of STEMI

Class I

1. Primary care providers should evaluate the presence and status of control of major risk factors for coronary heart disease (CHD) for all patients at regular intervals (approximately every 3 to 5 years). *(Level of Evidence: C)*

2. Ten-year risk [National Cholesterol Education Program (NCEP) global risk] of developing symptomatic CHD should be calculated for all patients who have 2 or more major risk factors to assess the need for primary prevention strategies. *(Level of Evidence: B)*

3. Patients with established CHD should be identified for secondary prevention, and patients with a CHD risk equivalent (e.g., diabetes mellitus, chronic kidney disease, or 10-year risk greater than 20% as calculated by Framingham equations) should receive equally intensive risk factor intervention as those with clinically apparent CHD. *(Level of Evidence: A)*

B. Recommendations for Patient Education for Early Recognition and Response to STEMI

Class I

1. Patients with symptoms of STEMI [chest discomfort with or without radiation to the arms(s), back, neck, jaw, or epigastrium; shortness of breath; weakness; diaphoresis; nausea; lightheadedness] should be transported to the hospital by ambulance rather than by friends or relatives. *(Level of Evidence: B)*

2. Healthcare providers should actively address the following issues regarding STEMI with patients and their families:

a. the patient's heart attack risk *(Level of Evidence: C)*

b. how to recognize symptoms of STEMI *(Level of Evidence: C)*

c. the advisability of calling 9-1-1 if symptoms are unimproved or worsening after 5 minutes, despite feelings of uncertainty and fear of potential embarrassment *(Level of Evidence: C)*

d. 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. *(Level of Evidence: C)*

3. Healthcare providers should instruct patients for whom nitroglycerin has been prescribed previously to take ONE nitroglycerin dose sublingually in response to chest discomfort/pain. If chest discomfort/pain is unimproved or worsening 5 minutes

after 1 sublingual nitroglycerin dose has been taken, it is recommended that the patient or family member/friend be instructed to call 9-1-1 immediately to access EMS. *(Level of Evidence: C)*

III. Onset of STEMI

A. Prehospital Issues

Figure 2. Options for Transportation of Patients With STEMI and Initial Reperfusion Treatment

Panel A, Patient transported by EMS after calling 9-1-1:
Reperfusion in patients with STEMI can be accomplished by the pharmacological (fibrinolysis) or catheter-based [primary percutaneous coronary intervention (PCI)] approaches. Implementation of these strategies varies based on the mode of transportation of the patient and capabilities at the receiving hospital. Transport time to the hospital is variable from case to case, but the goal is to keep total ischemic time within 120 minutes. There are 3 possibilities: (1) If EMS has fibrinolytic capability and the patient qualifies for therapy, prehospital fibrinolysis should be started within 30 minutes of EMS arrival on scene. (2) If EMS is not capable of administering prehospital fibrinolysis and the patient is transported to a non–PCI-capable hospital, the hospital door-to-needle time should be within 30 minutes for patients in whom fibrinolysis is indicated. (3) If EMS is not capable of administering prehospital fibrinolysis and the patient is transported to a PCI-capable hospital, the hospital door-to-balloon time should be within 90 minutes.

Interhospital transfer: It is also appropriate to consider emergency interhospital transfer of the patient to a PCI-capable hospital for mechanical revascularization if (1) there is a contraindication to

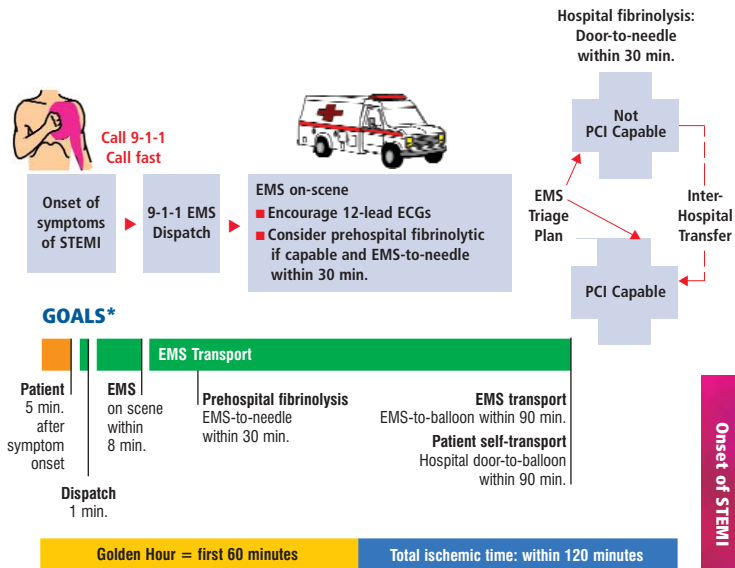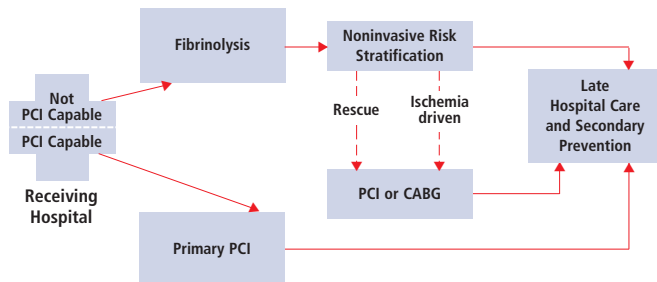fibrinolysis; (2) PCI can be initiated promptly (within 90 minutes after the patient presented to the initial receiving hospital or within 60 minutes compared to when fibrinolysis with a fibrin-specific agent could be initiated at the initial receiving hospital); or (3) fibrinolysis is administered and is unsuccessful (i.e., "rescue PCI"). Secondary nonemergency interhospital transfer can be considered for recurrent ischemia.

Patient self-transport: Patient self-transportation is discouraged. If the patient arrives at a non–PCI-capable hospital, the door-to-needle time should be within 30 minutes. If the patient arrives at a PCI-capable hospital, the door-to-balloon time should be within 90 minutes. The treatment options and time recommendations after first hospital arrival are the same.

Panel B, For patients who receive fibrinolysis, noninvasive risk stratification is recommended to identify the need for rescue PCI (failed fibrinolysis) or ischemia-driven PCI. Regardless of the initial method of reperfusion treatment, all patients should receive late hospital care and secondary prevention of STEMI.

EMS = emergency medical system; **CABG** = coronary artery bypass graft surgery.

*The medical system goal is to facilitate rapid recognition and treatment of patients with STEMI such that door-to-needle (or medical contact–to-needle) time for initiation of fibrinolytic therapy is within 30 minutes or that door-to-balloon (or medical contact–to-balloon) time for PCI is within 90 minutes. These goals should not be understood as ideal times but rather as the longest times that should be considered acceptable for a given system. Systems that are able to achieve even more rapid times for treatment of patients with STEMI should be encouraged.

Modified with permission from Armstrong et al. Circulation 2003;107:2533.

B. Initial Recognition and Management in the Emergency Department

Figure 3. Emergency Department Algorithm/Protocol for Patients With Symptoms and Signs of STEMI

*Do not give if systolic blood pressure is less than 90 mm Hg or less than 30 mm Hg below baseline, heart rate is less than 50 bpm or greater than 100 bpm, or right ventricular infarction is suspected.

†Oral beta-blockers in all patients without contraindications (Class I; Level of Evidence: A); IV beta-blockers are reasonable for patients unless contraindicated, especially if a tachyarrhythmia or hypertension is present (Class IIa; Level of Evidence: B).

‡Although some trials have used enteric-coated aspirin for initial dosing, more rapid buccal absorption occurs with non–enteric-coated formulations.

STEMI = ST-elevation myocardial infarction; **ED** = emergency department; **IV** = intravenous; **D₅W** = 5% dextrose in water; **bpm** = beats per minute.

14

15

Table 2. Brief Physical Examination in the Emergency Department

1. Airway, Breathing, Circulation (ABC)
2. Vital signs, general observation
3. Presence or absence of jugular venous distension
4. Pulmonary auscultation for rales
5. Cardiac auscultation for murmurs and gallops
6. Presence or absence of stroke
7. Presence or absence of pulses
8. Presence or absence of systemic hypoperfusion (cool, clammy, pale, ashen)

Table 3. Differential Diagnosis of STEMI

Life-threatening	Aortic dissection	Tension pneumothorax
	Pulmonary embolus	Boerhaave syndrome (esophageal rupture with mediastinitis)
	Perforating ulcer	
Other cardiovascular and nonischemic	Pericarditis	LV hypertrophy with strain
	Atypical angina	Brugada syndrome
	Early repolarization	Myocarditis
	Wolff-Parkinson-White syndrome	Hyperkalemia
	Deeply inverted T-waves suggestive of a central nervous system lesion or apical hypertrophic cardiomyopathy	Bundle-branch blocks
		Vasospastic angina
		Hypertrophic cardiomyopathy
Other noncardiac	Gastroesophageal reflux (GERD) and spasm	Biliary or pancreatic pain
	Chest-wall pain	Cervical disc or neuropathic pain
	Pleurisy	Somatization and psychogenic pain disorder
	Peptic ulcer disease	
	Panic attack	

STEMI = ST-elevation myocardial infarction; LV = left ventricular.

Table 4. Reperfusion Checklist for Evaluation of the Patient With STEMI

Step One

Has the patient experienced chest discomfort for greater than 15 min and less than 12 hours?

Yes — No — STOP
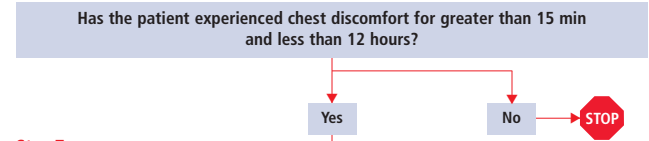
Step Two

Are there contraindications to fibrinolysis?
If ANY of the following are CHECKED "YES", fibrinolysis MAY be contraindicated.

Systolic BP greater than 180 mm Hg	☐ Yes	No
Diastolic BP greater than 110 mm Hg	☐ Yes	No
Right vs. left arm systolic BP difference greater than 15 mm Hg	☐ Yes	No
History of structural central nervous system disease	☐ Yes	No
Significant closed head/facial trauma within the previous 3 months	☐ Yes	No
Recent (within 6 wks) major trauma, surgery (including laser eye surgery), GI/GU bleed	☐ Yes	No
Bleeding or clotting problem or on blood thinners	☐ Yes	No
CPR greater than 10 min	☐ Yes	No
Pregnant female	☐ Yes	No
Serious systemic disease (e.g., advanced/terminal cancer, severe liver or kidney disease)	☐ Yes	No

Step Three

Does the patient have severe heart failure or cardiogenic shock such that PCI is preferable?

Pulmonary edema (rales greater than halfway up)	☐ Yes	No
Systemic hypoperfusion (cool, clammy)	☐ Yes	No

STEMI = ST-elevation myocardial infarction; BP = blood pressure; GI = gastrointestinal; GU = genitourinary; CPR = cardiopulmonary resuscitation; PCI = percutaneous coronary intervention.

Table 5. Assessment of Reperfusion Options for Patients With STEMI

Step 1: Assess Time and Risk
- Time since onset of symptoms
- Risk of STEMI
- Risk of fibrinolysis
- Time required for transport to a skilled PCI laboratory

Step 2: Determine Whether Fibrinolysis or an Invasive Strategy Is Preferred

If presentation is less than 3 hours and there is no delay to an invasive strategy, there is no preference for either strategy

Fibrinolysis is generally preferred if:

- **Early presentation** (less than or equal to 3 hours from symptom onset and delay to invasive strategy; see below)
- **Invasive strategy is not an option**
  - Catheterization laboratory occupied/not available
  - Vascular access difficulties
  - Lack of access to a skilled PCI laboratory†‡
- **Delay to invasive strategy**
  - Prolonged transport
  - (Door-to-Balloon) – (Door-to-Needle) time is more than 1 hour*§
  - Medical contact–to-balloon or door-to-balloon time is more than 90 minutes

See Table 11 and pull-out card for dosing information for fibrinolytic therapy and Table 6 for contraindi-cations/cautions

An invasive strategy is generally preferred if:

- **Skilled PCI laboratory†‡ available with surgical backup**
  - Medical contact–to-balloon or door-to-balloon is less than 90 minutes
  - (Door-to-Balloon) – (Door-to-Needle) is less than 1 hour*
- **High risk from STEMI**
  - Cardiogenic shock
  - Killip class is greater than or equal to 3
- **Contraindications to fibrinolysis,** including increased risk of bleeding and intracranial hemorrhage
- **Late Presentation**
  - The symptom onset was more than 3 hours ago
- **Diagnosis of STEMI is in doubt**

See pages 20-22 for recommendations for primary PCI

STEMI = ST-elevation myocardial infarction; **PCI** = percutaneous coronary intervention.

*Applies to fibrin-specific agents.

†Operator experience greater than a total of 75 primary PCI cases per year.

‡Team experience greater than a total of 36 primary PCI cases per year.

§This calculation implies that the estimated delay to implementation of the invasive strategy is more than 1 hour versus immediate initiation of fibrinolytic therapy with a fibrin-specific agent.

Table 6. Contraindications and Cautions for Fibrinolysis in STEMI*

Absolute Contraindications	Any prior intracranial hemorrhage
	Known structural cerebral vascular lesion (e.g., arteriovenous malformation)
	Known malignant intracranial neoplasm (primary or metastatic)
	Ischemic stroke within 3 months EXCEPT acute ischemic stroke within 3 hours
	Suspected aortic dissection
	Active bleeding or bleeding diathesis (excluding menses)
	Significant closed-head or facial trauma within 3 months

Relative Contraindications	History of chronic, severe, poorly controlled hypertension
	Severe uncontrolled hypertension on presentation (SBP greater than 180 mm Hg or DBP greater than 110 mm Hg)†
	History of prior ischemic stroke greater than 3 months, dementia, or known intracranial pathology not covered in contraindications
	Traumatic or prolonged (greater than 10 minutes) CPR or major surgery (within less than 3 weeks)
	Recent (within 2 to 4 weeks) internal bleeding
	Noncompressible vascular punctures
	For streptokinase/anistreplase: prior exposure (more than 5 days ago) or prior allergic reaction to these agents
	Pregnancy
	Active peptic ulcer
	Current use of anticoagulants: the higher the INR, the higher the risk of bleeding

STEMI = ST-elevation myocardial infarction;
SBP = systolic blood pressure; **DBP** = diastolic blood pressure;
INR = international normalized ratio.

*Viewed as advisory for clinical decision making and may not be all-inclusive or definitive.

†Could be an absolute contraindication in low-risk patients with STEMI (see Section 6.3.1.6.3.2 in the full-text guidelines).

Recommendations for Primary PCI

See Table 5 regarding additional considerations for selecting reperfusion therapy.

Class I **General Considerations:**

1. If immediately available, primary PCI should be performed in patients with STEMI (including true posterior MI) or MI with new or presumably new left bundle-branch block (LBBB) who can undergo PCI of the infarct artery within 12 hours of symptom onset, if performed in a timely fashion (balloon inflation within 90 minutes of presentation) by persons skilled in the procedure (individuals who perform more than 75 PCI procedures per year). The procedure should be supported by experienced personnel in an appropriate laboratory (one that performs more than 200 PCI procedures per year, of which at least 36 are primary PCI for STEMI, and that has cardiac surgery capability). *(Level of Evidence: A)*

Specific Considerations:

a. Primary PCI should be performed as quickly as possible, with the goal of a medical contact–to-balloon or door-to-balloon time of within 90 minutes. *(Level of Evidence: B)*

b. If the symptom duration is within 3 hours and the expected door-to-balloon time minus the expected door-to-needle time is:

■ within 1 hour, primary PCI is generally preferred *(Level of Evidence: B)*

■ greater than 1 hour, fibrinolytic therapy (fibrin-specific agents) is generally preferred. *(Level of Evidence: B)*

c. If symptom duration is greater than 3 hours, primary PCI should be performed with a medical contact–to-balloon or door-to-balloon time as brief as possible, with a goal of within 90 minutes. *(Level of Evidence: B)*

d. Primary PCI should be performed for patients less than 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. *(Level of Evidence: A)*

e. Primary PCI should be performed in patients with severe congestive heart failure and/or pulmonary edema (Killip class 3) and onset of symptoms within 12 hours. The medical contact–to-balloon or door-to-balloon time should be as short as possible, with a goal of within 90 minutes. *(Level of Evidence: B)*

Class IIa 1. Primary PCI is reasonable for selected patients 75 years or older 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. Patients with good prior functional status who are suitable for revascularization and agree to invasive care may be selected for an invasive strategy. *(Level of Evidence: B)*

2. It is reasonable to perform primary PCI for patients with onset of symptoms within the prior 12 to 24 hours and one or more of the following:

a. severe congestive heart failure *(Level of Evidence: C)*

b. hemodynamic or electrical instability *(Level of Evidence: C)*

c. persistent ischemic symptoms. *(Level of Evidence: C)*

Class IIb   1. The benefit of primary PCI for STEMI patients eligible for fibrinolysis is not well established when performed by an operator who performs fewer than 75 PCI procedures per year. *(Level of Evidence: C)*

Class III   1. Primary PCI should not be performed in a non-infarct artery in patients without hemodynamic compromise. *(Level of Evidence: C)*

2. Primary PCI should not be performed in asymptomatic patients more than 12 hours after onset of STEMI if they are hemodynamically and electrically stable. *(Level of Evidence: C)*

Pharmacological Support During Primary PCI

Unfractionated Heparin	No GP IIb/IIIa Inhibitor	GP IIb/IIIa Inhibitor Used
Bolus:	70-100 U/kg	50-70 U/kg
Target ACT:	HemoTec: 250-300 s	With either device: 200 s
	Hemochron: 300-350 s	
	(Class I: Level of Evidence: C)	

Thienopyridine	
Clopidogrel	■ Administer loading dose
	■ Maintenance dose: 75 mg orally per day
	■ Duration:
	i) Bare metal stent—1 month minimum
	ii) Drug-eluting stent—minimum of 3 months after sirolimus and 6 months after paclitaxel
	Continue for 12 months after stent implantation (both types of stents) in patients who are not at risk of bleeding. *(Class I: Level of Evidence: B)*

GP IIb/IIIa Inhibitors	
	■ It is reasonable to start abciximab as early as possible before primary PCI (with or without stenting). The recommended dosage of abciximab in adults is a 0.25 mg/kg intravenous bolus administered 10 to 60 minutes before the start of PCI, followed by a continuous intravenous infusion of 0.125 mcg/kg/min (to a maximum of 10 mcg/min) for 12 to 18 hours. *(Class IIa; Level of Evidence: B)*
	■ Treatment with tirofiban (bolus dose of 10 mcg per kilogram of body weight, followed by an infusion of 0.15 mcg/kg/min for 18 to 24 hours) or eptifibatide (for patients with serum creatinine less than 2.0 mg/dL,* an intravenous bolus of 180 mcg/kg administered immediately before the initiation of PCI followed by a continuous infusion of 2.0 mcg/kg/min and a second 180 mcg/kg bolus 10 minutes after the first bolus. Infusion should be continued until hospital discharge, or for up to 18 to 24 hours, whichever comes first) may be considered before primary PCI (with or without stenting). *(Class IIb; Level of Evidence: C)*

*For patients with a serum creatinine greater than 2.0 mg/dL, an intravenous bolus of 180 mcg/kg administered immediately before initiation of the procedure, immediately followed by a continuous infusion of 1.0 mcg/kg/min and a second 180 mcg/kg bolus administered 10 minutes after the first.

GP = glycoprotein; **ACT** = activated clotting time; **U** = units; **s** = seconds.

Table 7.
Laboratory Evaluations for Management of STEMI

Serum biomarkers for cardiac damage
(do not wait for results before implementing
reperfusion strategy)

Complete blood count with platelet count

INR (international normalized ratio)

Activated partial thromboplastin time

Electrolytes and magnesium

BUN (blood urea nitrogen)

Creatinine

Glucose

Serum lipids

IV. Hospital Management

Table 8. Sample Admitting Orders for Patients With STEMI

1. Condition: Serious

2. IV: NS on D$_5$W to keep vein open. Start a second IV if IV medication is being given. This may be a saline lock.

3. Vital signs: Every 1.5 hours until stable, then every 4 hours and as needed. Notify physician if HR is less than 60 bpm or greater than 100 bpm, BP is less than 100 mm Hg systolic or greater than 150 mm Hg diastolic, respiratory rate is less than 8 or greater than 22 bpm.

4. Monitor: Continuous ECG monitoring for arrhythmia and ST-segment deviation.

5. Diet: NPO except for sips of water until stable. Then start diet with 2 g of sodium per day, low saturated fat (less than 7% of total calories/day), low cholesterol (less than 200 mg/day), such as Total Lifestyle Change (TLC) diet.

6. Activity: Bedside commode and light activity when stable.

7. Oxygen: Continuous oximetry monitoring. Nasal cannula at 2 L/min when stable for 6 hours, reassess for oxygen need (i.e., O$_2$ saturation less than 90%), and consider discontinuing oxygen.

8. Medications:

a. Nitroglycerin

1. Use sublingual NTG 0.4 mg every 5 minutes as needed for chest pain or discomfort.

2. Intravenous NTG for CHF, hypertension, or persistent ischemia that responds to nitrate therapy.

b. Aspirin

1. If aspirin not given in the ED, chew non–enteric-coated aspirin[†] 162 to 325 mg.

2. If aspirin has been given, start daily maintenance of 75 to 162 mg. May use enteric-coated aspirin for gastro-intestinal protection.

c. Beta-Blocker

1. If not given in the ED, assess for contraindications, i.e., bradycardia and hypotension. Continue daily assessment to ascertain eligibility for beta-blocker.

2. If given in the ED, continue daily dose and optimize as dictated by HR and BP.

d. ACE Inhibitor

1. Start ACE inhibitor orally in patients with anterior infarction, pulmonary congestion, or LVEF less than 0.40 if the following are absent: hypotension (SBP less than 100 mm Hg or less than 30 mm Hg below baseline) or known contraindications to this class of medications.

e. Angiotensin Receptor Blocker

1. Start ARB orally in patients who are intolerant of ACE inhibitors and who have either clinical or radiological signs of heart failure or LVEF less than 0.40.

f. Pain Medications

1. IV morphine sulfate 2 to 4 mg with increments of 2 to 8 mg IV at 5- to 15-minute intervals as needed to control pain.

g. Anxiolytics (based on a nursing assessment)

h. Daily Stool Softener

9. Laboratory Tests: Serum biomarkers for cardiac damage,[*] CBC with platelet count, INR, aPTT, electrolytes, magnesium, BUN, creatinine, glucose, serum lipids.

STEMI = ST-elevation myocardial infarction; **IV** = intravenous; **NS** = normal saline; **D₅W** = 5% dextrose in water; **HR** = heart rate; **BP** = blood pressure; **NPO** = nothing by mouth; **NTG** = nitroglycerin; **CHF** = congestive heart failure; **ED** = emergency department; **ACE** = angiotensin converting enzyme; **LVEF** = left ventricular ejection fraction; **SBP** = systolic blood pressure; **ARB** = angiotensin receptor blocker; **CBC** = complete blood count; **INR** = international normalized ratio; **aPTT** = activated partial thromboplastin time; **BUN** = blood urea nitrogen.

*Do not wait for results before implementing reperfusion strategy.

†Although some trials have used enteric-coated aspirin for initial dosing, more rapid buccal absorption occurs with non–enteric-coated formulations.

Modified with permission from Ryan et al. J Am Coll Cardiol 1999;34:890-911.

Figure 4. Emergency Management of Complicated STEMI

Clinical Signs: shock, hypoperfusion, congestive heart failure, acute pulmonary edema
Most likely major underlying disturbance?

Acute pulmonary edema

Administer
- **Furosemide** IV 0.5 to 1.0 mg/kg*
- **Morphine** IV 2 to 4 mg
- **Oxygen**/intubation as needed
- **Nitroglycerin** SL, then 10 to 20 mcg/min IV if SBP greater than 100 mm Hg
- **Dopamine** 5 to 15 mcg/kg per minute IV if SBP 70 to 100 mm Hg and signs/symptoms of shock present
- **Dobutamine** 2 to 20 mcg/kg per minute IV if SBP 70 to 100 mm Hg and **NO** signs/symptoms of shock

Check blood pressure

Systolic BP greater than 100 mm Hg and not less than 30 mm Hg below baseline

ACE Inhibitors
Short-acting agent such as captopril (1 to 6.25 mg)

Hypovolemia

Administer
- **Fluids**
- **Blood transfusions**
- **Cause-specific interventions**

Consider vasopressors

Low Output—Cardiogenic Shock

Check blood pressure

Systolic BP greater than 100 mm Hg	Systolic BP 70 to 100 mm Hg NO signs/symptoms of shock	Systolic BP 70 to 100 mm Hg Signs/symptoms of shock	Systolic BP less than 70 mm Hg Signs/symptoms of shock
Nitroglycerin 10 to 20 mcg/min IV	**Dobutamine** 2 to 20 mcg/kg per minute IV	**Dopamine** 5 to 15 mcg/kg per minute IV	**Norepinephrine** 0.5 to 30 mcg/min IV

Arrhythmia

Bradycardia

Tachycardia

See Section 7.7 in the full-text guidelines

First line of action

Second line of action

Third line of action

Hospital Management

Further diagnostic/therapeutic considerations:
(should be considered in non-hypovolemic shock)

Diagnostic
- Pulmonary artery catheter
- Echocardiography
- Angiography for MI/ischemia
- Additional diagnostic studies

Therapeutic
- Intra-aortic balloon pump
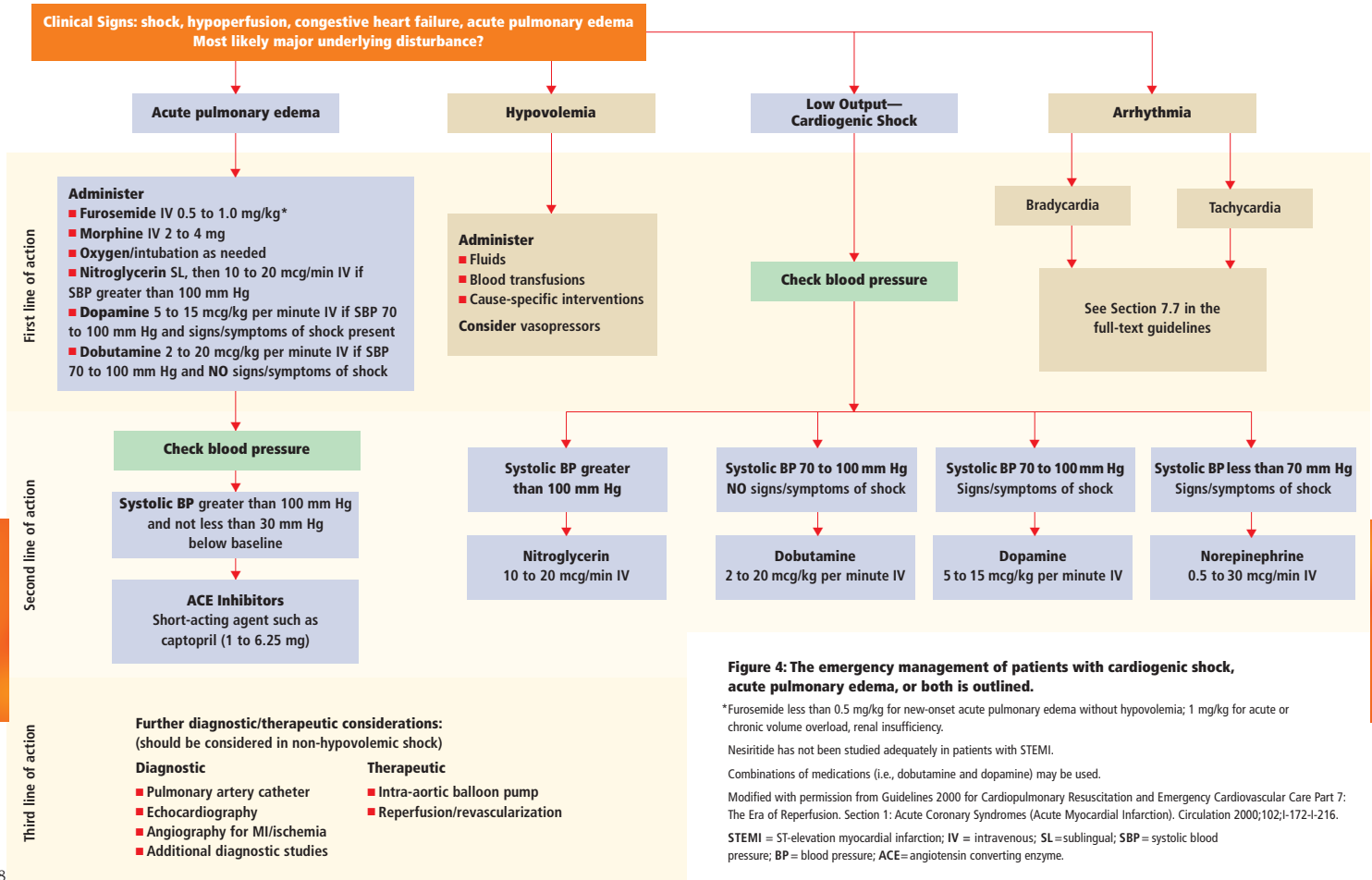- Reperfusion/revascularization

Figure 4: The emergency management of patients with cardiogenic shock, acute pulmonary edema, or both is outlined.

*Furosemide less than 0.5 mg/kg for new-onset acute pulmonary edema without hypovolemia; 1 mg/kg for acute or chronic volume overload, renal insufficiency.

Nesiritide has not been studied adequately in patients with STEMI.

Combinations of medications (i.e., dobutamine and dopamine) may be used.

Modified with permission from Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Part 7: The Era of Reperfusion. Section 1: Acute Coronary Syndromes (Acute Myocardial Infarction). Circulation 2000;102;I-172-I-216.

STEMI = ST-elevation myocardial infarction; **IV** = intravenous; **SL** = sublingual; **SBP** = systolic blood pressure; **BP** = blood pressure; **ACE** = angiotensin converting enzyme.

Table 9. Characteristics of Ventricular Septal Rupture, Rupture of the Ventricular Free Wall, and Papillary Muscle Rupture
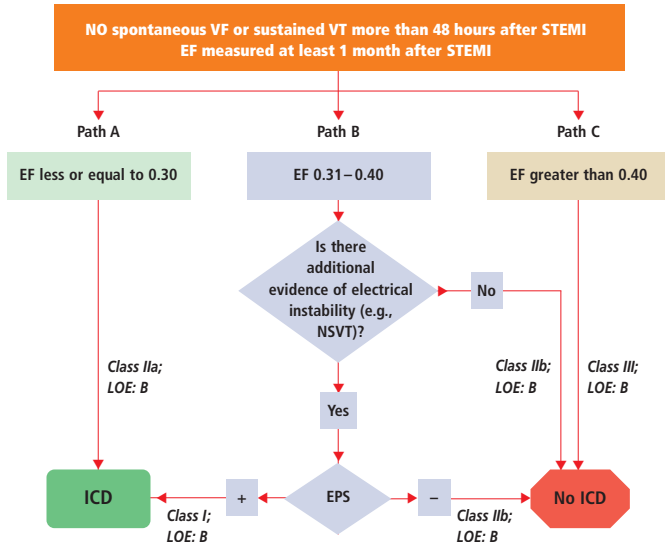
Characteristic	Ventricular Septal Rupture	Rupture of Ventricular Free Wall	Papillary Muscle Rupture
Incidence	1-3% without reperfusion therapy, 0.2-0.34% with fibrinolytic therapy, 3.9% among patients with cardiogenic shock	0.8-6.2%, Fibrinolytic therapy does not reduce risk; primary PTCA seems to reduce risk	About 1% (posteromedial more frequent than anterolateral papillary muscle)
Time course	Bimodal peak; within 24 hours and 3-5 days; range 1-14 days	Bimodal peak; within 24 hours and 3-5 days; range 1-14 days	Bimodal peak; within 24 hours and 3-5 days; range 1-14 days
Clinical manifestations	Chest pain, shortness of breath, hypotension	Anginal, pleuritic, or pericardial chest pain, syncope, hypotension, arrhythmia, nausea, restlessness, hypotension, sudden death	Abrupt onset of shortness of breath and pulmonary edema; hypotension
Physical findings	Harsh holosystolic murmur, thrill (+), S_3, accentuated 2nd heart sound, pulmonary edema, RV and LV failure, cardiogenic shock	Jugulovenous distention (29% of patients), pulsus paradoxus (47%), electromechanical dissociation, cardiogenic shock	A soft murmur in some cases, no thrill, variable signs of RV overload, severe pulmonary edema, cardiogenic shock
Echocardiographic findings	Ventricular septal rupture, left-to-right shunt on color flow Doppler echocardiography through the ventricular septum, pattern of RV overload	Greater than 5 mm pericardial effusion not visualized in all cases, layered, high-acoustic echoes within the pericardium (blood clot), direct visualization of tear, signs of tamponade	Hypercontractile LV, torn papillary muscle or chordae tendineae, flail leaflet, severe MR on color flow Doppler echocardiography
Right-heart catheterization	Increase in oxygen saturation from the RA to RV, large V-waves	Ventriculography insensitive, classic signs of tamponade not always present (equalization of diastolic pressures among the cardiac chambers)	No increase in oxygen saturation from the RA to RV, large V-waves,* very high pulmonary-capillary wedge pressures

PTCA = percutaneous transluminal coronary angioplasty; **RV** = right ventricular/ventricle; **LV** = left ventricular; **RA** = right atrium.

*Large V-waves are from the pulmonary capillary wedge pressure.

Modified with permission from Birnbaum et al. N Engl J Med 2002;347:1426-32

Figure 5. Algorithm to Aid in Selection of ICD in Patients With STEMI and Diminished EF

NO spontaneous VF or sustained VT more than 48 hours after STEMI
EF measured at least 1 month after STEMI

Path A — EF less or equal to 0.30
Path B — EF 0.31–0.40
Path C — EF greater than 0.40

Is there additional evidence of electrical instability (e.g., NSVT)? — No / Yes

EPS + / −

Class IIa; LOE: B
Class IIb; LOE: B
Class III; LOE: B
Class I; LOE: B
Class IIb; LOE: B

ICD / No ICD

The appropriate management path is selected based on EF measured at least 1 month after STEMI. These criteria, which are based on the published data, form the basis for the full-text guidelines in Section 7.7.1.5. All patients, whether an ICD is implanted or not, should receive medical therapy as outlined in the full-text guidelines.

ICD = implantable cardioverter defibrillator; **STEMI** = ST-elevation myocardial infarction; **EF** = ejection fraction; **VF** = ventricular fibrillation; **VT** = ventricular tachycardia; **NSVT** = nonsustained ventricular tachycardia; **LOE** = level of evidence; **EPS** = electrophysiological study.

## Figure 6. Algorithm for Management of Recurrent Ischemia/Infarction After STEMI

Recurrent ischemic-type discomfort at rest after STEMI

- Escalation of medical therapy (nitrates, beta-blockers)
- Anticoagulation if not already given
- Consider IABP for hemodynamic instability, poor LV function, or a large area of myocardium at risk
- Correct secondary causes of ischemia

Obtain 12-lead ECG

ST-segment elevation? — Yes / No

Is patient a candidate for revascularization? — Yes / No

Is ischemia controlled by escalation of medical therapy? — Yes / No

Can catheterization be performed promptly?* — Yes / No

Consider (re)administration of fibrinolytic therapy

Refer for nonurgent catheterization

Refer for urgent catheterization (consider IABP)

Coronary angiography

Revascularization with PCI and/or CABG as dictated by anatomy

Consider (re)administration of fibrinolytic therapy

*Ideally within 60 minutes of onset of recurrent discomfort.

IABP = intra-aortic balloon pump; **LV** = left ventricular; **CABG** = coronary artery bypass graft surgery; **PCI** = percutaneous coronary intervention.

Modified with permission from Braunwald E, Zipes D, Libby P. Heart Disease: A Textbook of Cardiovascular Medicine. 6th ed. Philadelphia, PA: WB Saunders Co. Ltd. 2001:1195.

Hospital Management

32

33

Figure 7. Evidence-Based Approach to Need for Catheterization and Revascularization After STEMI
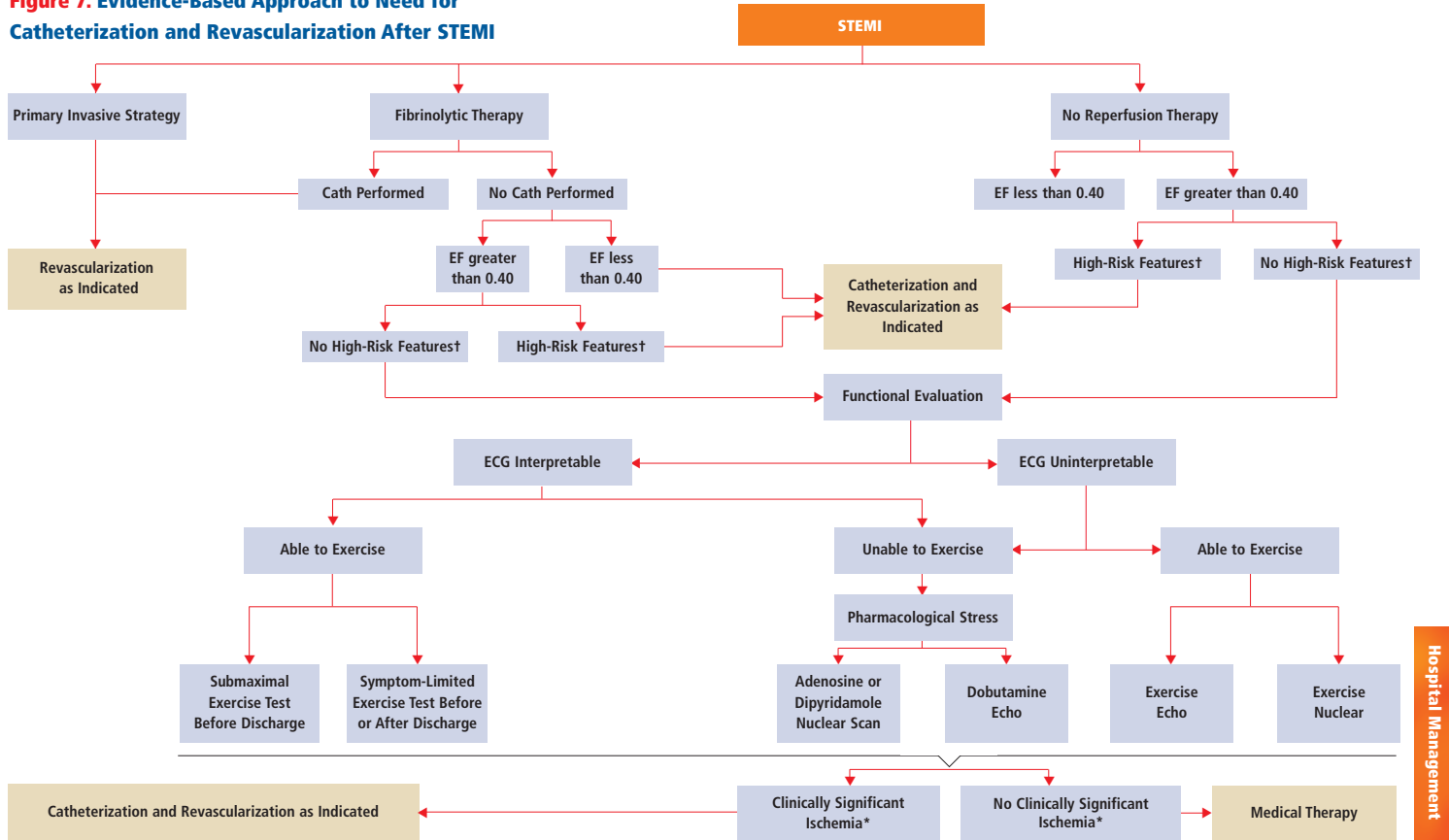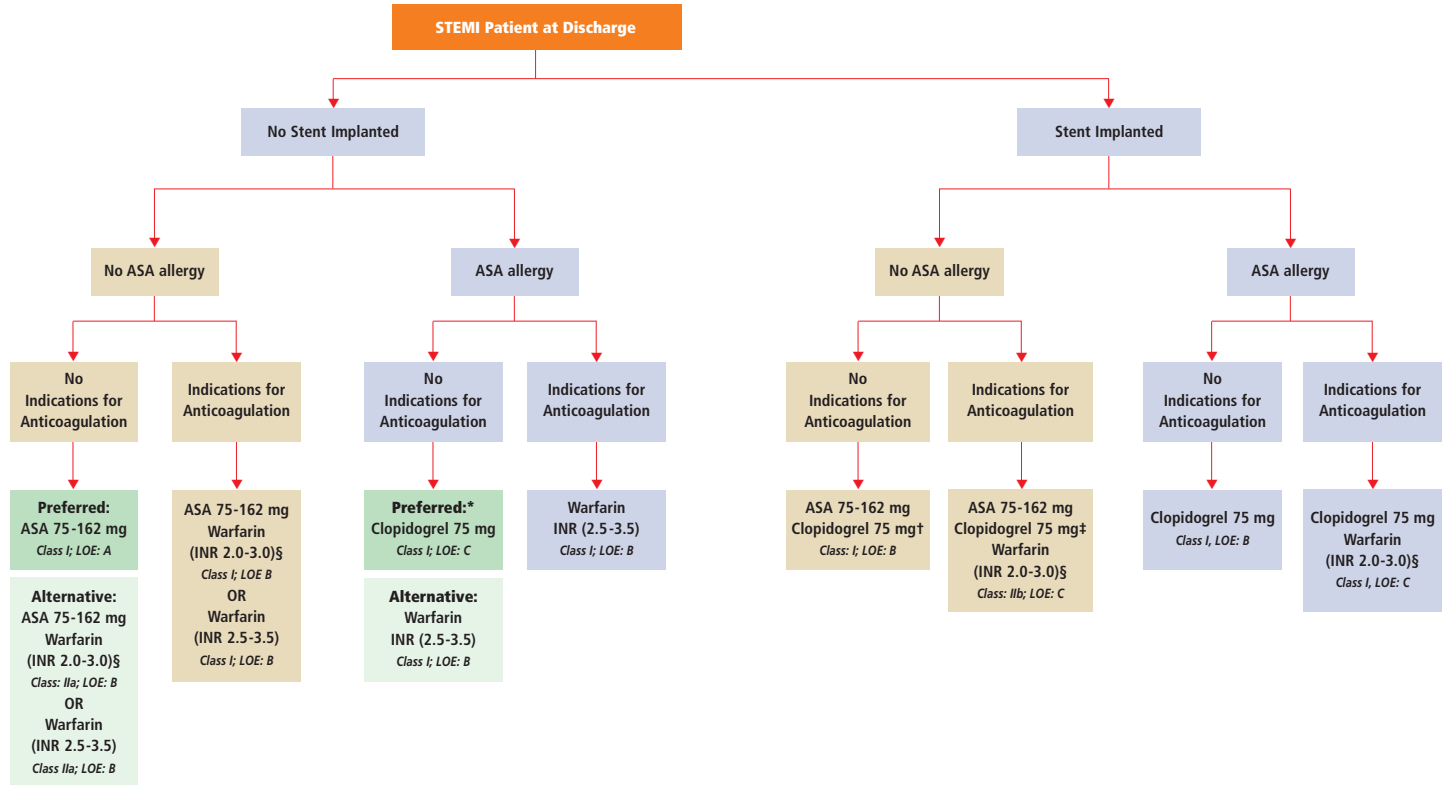

This algorithm shows treatment paths for patients who initially undergo a primary invasive strategy, receive fibrinolytic therapy, or do not undergo reperfusion therapy for STEMI. Patients who have not undergone a primary invasive strategy and have no high-risk features should undergo functional evaluation 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.

STEMI = ST-elevation myocardial infarction; Cath = catheterization; EF = ejection fraction; ECG = electrocardiogram.

*Please see Table 23 in the ACC/AHA Guidelines for the Management of Patients With Chronic Stable Angina for further definition.

†Please see Table 4 in the Pocket Guide and Sections 6.3.1.6.2 and 7.3 in the full-text guidelines for further discussion.

Figure 8. Long-Term Antithrombotic Therapy at Hospital Discharge After STEMI

```
                              STEMI Patient at Discharge
                    ┌─────────────────────────┴─────────────────────────┐
            No Stent Implanted                                    Stent Implanted
        ┌───────────┴───────────┐                          ┌───────────┴───────────┐
   No ASA allergy          ASA allergy                 No ASA allergy          ASA allergy
```

No Stent Implanted / No ASA allergy

No Indications for Anticoagulation

Preferred:
ASA 75-162 mg
Class I; LOE: A

Alternative:
ASA 75-162 mg
Warfarin
(INR 2.0-3.0)§
Class IIa; LOE: B
OR
Warfarin
(INR 2.5-3.5)
Class IIa; LOE: B

Indications for Anticoagulation

ASA 75-162 mg
Warfarin
(INR 2.0-3.0)§
Class I; LOE B
OR
Warfarin
(INR 2.5-3.5)
Class I; LOE: B

No Stent Implanted / ASA allergy

No Indications for Anticoagulation

Preferred:*
Clopidogrel 75 mg
Class I; LOE: C

Alternative:
Warfarin
INR (2.5-3.5)
Class I; LOE: B

Indications for Anticoagulation

Warfarin
INR (2.5-3.5)
Class I; LOE: B

Stent Implanted / No ASA allergy

No Indications for Anticoagulation

ASA 75-162 mg
Clopidogrel 75 mg†
Class I; LOE: B

Indications for Anticoagulation

ASA 75-162 mg
Clopidogrel 75 mg‡
Warfarin
(INR 2.0-3.0)§
Class: IIb; LOE: C

Stent Implanted / ASA allergy

No Indications for Anticoagulation

Clopidogrel 75 mg
Class I, LOE: B

Indications for Anticoagulation

Clopidogrel 75 mg
Warfarin
(INR 2.0-3.0)§
Class I, LOE: C

---

* Clopidogrel is preferred over warfarin because of increased risk of bleeding and low patient compliance in warfarin trials.

† For 12 months.

‡ Discontinue clopidogrel 1 month after implantation of a bare metal stent or several months after implantation of a drug-eluting stent (3 months after sirolimus and 6 months after paclitaxel) because of the potential increased risk of bleeding with warfarin and 2 antiplatelet agents. Continue aspirin and warfarin long term if warfarin is indicated for other reasons such as atrial fibrillation, LV thrombus, cerebral emboli, or extensive regional wall-motion abnormality.

§ An INR of 2.0 to 3.0 is acceptable with tight control, but the lower end of this range is preferable. The combination of antiplatelet therapy and warfarin may be considered in patients aged less than 75 years with low bleeding risk who can be monitored reliably.

STEMI = ST-elevation myocardial infarction; **ASA** = aspirin; **LOE** = level of evidence; **INR** = international normalized ratio; **LV** = left ventricular.

V. Secondary Prevention and Long-Term Management

Table 10. Secondary Prevention for Patients With STEMI

Goals	Recommendations
Smoking **Goal: Complete cessation**	Assess tobacco use. Strongly encourage patient and family to stop smoking and to avoid secondhand smoke. Provide counseling, pharmacological therapy (including nicotine replacement and bupropion), and formal smoking cessation programs as appropriate.
Blood pressure control **Goal: Less than 140/90 mm Hg or less than 130/80 mm Hg if chronic kidney disease or diabetes**	**If blood pressure is 120/80 mm Hg or greater:** ■ Initiate lifestyle modification (weight control, physical activity, alcohol moderation, moderate sodium restriction, and emphasis on fruits, vegetables, and low-fat dairy products) in all patients. **If blood pressure is 140/90 mm Hg or greater or 130/80 mm Hg or greater for individuals with chronic kidney disease or diabetes:** ■ Add blood pressure reducing medications, emphasizing the use of beta-blockers and inhibitors of the renin-angiotensin-aldosterone system.
Lipid management **(TG less than 200 mg/dL)** **Primary goal:** **LDL-C** *substantially* **less than 100 mg/dL**	Start dietary therapy in all patients (less than 7% of total calories as saturated fat and less than 200 mg/d cholesterol). Promote physical activity and weight management. Encourage increased consumption of omega-3 fatty acids. Assess fasting lipid profile in all patients, preferably within 24 hours of STEMI. Add drug therapy according to the following guide: **LDL-C less than 100 mg/dL (baseline or on treatment):** ■ Statins should be used to lower LDL-C. **LDL-C greater than or equal to 100 mg/dL (baseline or on treatment):** ■ Intensify LDL-C–lowering therapy with drug treatment, giving preference to statins.
Lipid management **(TG 200 mg/dL or greater)** **Primary goal:** **Non–HDL-C*** *substantially* **less than 130 mg/dL**	**If TGs are greater than or equal to 150 mg/dL or HDL-C is less than 40 mg/dL:** ■ Emphasize weight management and physical activity. Advise smoking cessation. **If TG is 200–499 mg/dL:** ■ After LDL-C–lowering therapy,† consider adding fibrate or niacin.‡ **If TG is greater than or equal to 500 mg/dL:** ■ Consider fibrate or niacin‡ before LDL-C–lowering therapy.† ■ Consider omega-3 fatty acids as adjunct for high TG.
Physical activity **Minimum goal:** **30 minutes 3 to 4 days per week;** **Optimal daily**	Assess risk, preferably with exercise test, to guide prescription. Encourage minimum of 30 to 60 minutes of activity, preferably daily but at least 3 or 4 times weekly (walking, jogging, cycling, or other aerobic activity) supplemented by an increase in daily lifestyle activities (eg, walking breaks at work, gardening, household work). Cardiac rehabilitation programs, when available, are recommended for patients with STEMI, particularly those with multiple modifiable risk factors and/or those moderate- to high-risk patients in whom supervised exercise training is warranted.

Weight management Goal: BMI 18.5-24.9 kg/m²	Calculate BMI and measure waist circumference as part of evaluation. Monitor response of BMI and waist circumference to therapy. Start weight management and physical activity as appropriate. Desirable BMI range is 18.5–24.9 kg/m².
Waist circumference: Women: less than 35 inches Men: less than 40 inches	If waist circumference is greater than or equal to 35 inches in women or greater than or equal to 40 inches in men, initiate lifestyle changes and treatment strategies for metabolic syndrome.
Diabetes management Goal: HbA1c less than 7%	Appropriate hypoglycemic therapy to achieve near-normal fasting plasma glucose, as indicated by HbA1c. Treatment of other risk factors (e.g., physical activity, weight management, blood pressure, and cholesterol management).
Antiplatelet agents/ anticoagulants	Start and continue indefinitely aspirin 75 to 162 mg/d if not contraindicated. Consider clopidogrel 75 mg/d or warfarin if aspirin is contraindicated. Manage warfarin to INR 2.5 to 3.5 in post-STEMI patients when clinically indicated or for those not able to take aspirin or clopidogrel (Figure 8).
Renin-Angiotensin-Aldosterone System Blockers	ACE inhibitors in all patients indefinitely; start early in stable high-risk patients [anterior MI, previous MI, Killip class greater than or equal to II (S_3 gallop, rales, radiographic CHF), LVEF less than 0.40]. Angiotensin receptor blockers in patients who are intolerant of ACE inhibitors and with either clinical or radiological signs of heart failure or LVEF less than 0.40. Aldosterone blockade in patients without significant renal dysfunction§ or hyperkalemia** who are already receiving therapeutic doses of an ACE inhibitor, have LVEF less than or equal to 0.40, and have either diabetes or heart failure.
Beta-Blockers	Start in all patients. Continue indefinitely. Observe usual contraindications.

ACE = angiotensin converting enzyme; **BP** = blood pressure; **BMI** = body mass index; **CHF** = congestive heart failure; **HDL-C** = high-density lipoprotein cholesterol; **INR** = International Normalized Ratio; **LDL-C** = low-density lipoprotein cholesterol; **LVEF** = left ventricular ejection fraction; **TG** = triglycerides; **MI** = myocardial infarction.

*Non–HDL-C = total cholesterol minus HDL-C.

†Treat to a goal of non-HDL-C substantially less than 130 mg/dL.

‡Dietary-supplement niacin must not be used as a substitute for prescription niacin, and over-the-counter niacin should be used only if approved and monitored by a physician.

§Creatinine should be less than or equal to 2.5 mg/dL in men or less than or equal to 2.0 mg/dL in women.

**Potassium should be less than or equal to 5.0 mEq/L.

Modified with permission from Smith et al. Circulation 2001;104:1577-9.

Class I

1. Follow-up visit should delineate the presence or absence of cardiovascular symptoms and functional class. *(Level of Evidence: C)*

2. The patient's list of current medications should be re-evaluated in a follow-up visit, and appropriate titration of angiotensin converting enzyme (ACE) inhibitors, beta-blockers, and statins should be undertaken. *(Level of Evidence: C)*

3. The predischarge risk assessment and planned workup should be reviewed and continued (Figure 7). This should include a check of left ventricular function and possibly Holter monitoring for those patients whose early post-STEMI ejection fraction was 0.31 to 0.40 or lower, in consideration of possible ICD use (Figure 5). *(Level of Evidence: C)*

4. The healthcare provider should review and emphasize the principles of secondary prevention with the patient and family members (Table 10). *(Level of Evidence: C)*

5. The psychosocial status of the patient should be evaluated in follow-up, including inquiries regarding symptoms of depression, anxiety, or sleep disorders and the social support environment. *(Level of Evidence: C)*

6. In a follow-up visit, the healthcare provider should discuss in detail issues of physical activity, return to work, resumption of sexual activity, and travel, including driving and flying. A table describing the metabolic equivalent (MET) values for various activities can be found in the full-text guidelines. *(Level of Evidence: C)*

7. Patients and their families should be asked if they are interested in CPR (cardiopulmonary resuscitation) training after the patient is discharged from the hospital. *(Level of Evidence: C)*

8. Providers should actively review the following issues with patients and their families:

a. the patient's heart attack risk *(Level of Evidence: C)*

b. how to recognize symptoms of STEMI *(Level of Evidence: C)*

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 *(Level of Evidence: C)*

d. a plan for appropriate recognition and response to a potential acute cardiac event, including the phone number to access EMS, generally 9-1-1. *(Level of Evidence: C)*

9. Cardiac rehabilitation/secondary prevention programs, when available, are recommended for patients with STEMI, particularly those with multiple modifiable risk factors and/or those moderate- to high-risk patients in whom supervised exercise training is warranted. *(Level of Evidence: C)*

Table 11. Drugs Commonly Used in the Management of Patients With STEMI††

Drug	First 24 Hours	During Hospitalization	At Discharge and Long-Term Follow-Up
Aspirin	Chewed (non–enteric-coated)** in the emergency department (162 to 325 mg)	75 to 162 mg daily	75 to 162 mg per day indefinitely
Fibrinolytic Therapy† (See Contraindications/ Cautions on Table 6)	Alteplase, IV bolus 15 mg, infusion 0.75 mg/kg times 30 min (maximum 50 mg), then 0.5 mg/kg not to exceed 35 mg over the next 60 min to an overall maximum of 100 mg Reteplase, 10 U IV over 2 min; 30 min after the first dose, give 10 U IV over 2 min Streptokinase, 1.5 MU IV over 30-60 min Tenecteplase, IV bolus over 10-15 seconds, 30 mg for weight less than 60 kg; 35 mg for 60-69 kg; 40 mg for 70-79 mg; 45 mg for 80-89 kg; 50 mg for 90 kg or more		
Unfractionated Heparin	60 U/kg (max 4000 U) as IV bolus, infusion 12 U/kg/hr (max 1000 U/hr) to maintain aPTT at 1.5 to 2.0 times control (approximately 50 to 70 seconds)	Maintain aPTT at 1.5 to 2.0 times control (approximately 50 to 70 seconds) for at least 48 hours	See Figure 8 for antithrombotic therapy recommendations
Beta-Blockers*	Oral daily	Oral daily	Oral daily indefinitely
ACE Inhibitors	ACE inhibitor to all patients with anterior infarction, pulmonary congestion, or LVEF less than 0.40 in the absence of hypotension or known contraindications; titrate and adjust for blood pressure and creatinine	Oral daily	Oral daily indefinitely

Drug	First 24 Hours	During Hospitalization	At Discharge and Long-Term Follow-Up
Angiotensin Receptor Blockers (ARB)	An ARB should be administered to patients intolereant of ACE inhibitors and with either clinical/radiological signs of heart failure or LVEF less than 0.40	Same as first 24 hours	Same as first 24 hours
Aldosterone Blockade		Aldosterone blockade in patients without significant renal dysfunction$‡$ or hyperkalemia$§$ who are already receiving therapeutic doses of an ACE inhibitor, have an LVEF of less than or equal to 0.40, and have either symptomatic heart failure or diabetes	Same as during hospitalization
Nitroglycerin	Sublingual NTG 0.4 mg every 5 min as needed for chest pain or discomfort Intravenous NTG for CHF, hypertension, or persistent ischemia that responds to nitrate therapy	Oral for ongoing ischemia or uncontrolled hypertension	
Statins		Start without lipid profile	Indefinitely if LDL-C is 100 mg/dL or greater; titrate until LDL-C is *substantially* less than 100 mg/dL
Morphine Sulfate	Intravenous morphine sulfate 2 to 4 mg with increments of 2 to 8 mg IV at 5- to 15-min intervals as needed to control pain		

aPTT = activated partial thromboplastin time; **ACE** = angiotensin converting enzyme;
LVEF = left ventricular ejection fraction; **NTG** = nitroglycerin; **CHF** = congestive heart failure;
LDL-C = low-density lipoprotein cholesterol; **IV** = intravenous.

*Cautions/relative contraindications: heart rate less than 60 bpm; PR interval greater than 0.24 seconds;
severe peripheral vascular disease; systolic arterial pressure less than 100 mm Hg; moderate or severe left
ventricular failure; signs of peripheral hypoperfusion, shock, second- or third-degree AV block; active
asthma or reactive airway disease.

†This list is in alphabetical order and is not meant to indicate a particular fibrinolytic therapy preference.

‡Creatinine should be less than or equal to 2.5 mg/dL in men or less than or equal to 2.0 mg/dL in women.

§Potassium should be less than or equal to 5.0 mEq/L.

**Although some trials have used enteric-coated aspirin for initial dosing, more rapid buccal absorption
occurs with non–enteric-coated formulations.

†† The ACC/AHA Class of Recommendation for the drugs listed in this table is *Class I.*

Table 12. Non-Pharmacological Therapy Commonly Used in Patients With STEMI*

Therapy	First 24 Hours	During Hospitalization	At Discharge and Long-Term Follow-Up
Patient Education			Education about lifestyle changes and drug therapies important for secondary prevention of cardiovascular disease; recognizing symptoms of a heart attack and calling 9-1-1 promptly
Dietary Advice		Education on diet that is low in saturated fat and cholesterol	Recommend diet that is low in saturated fat and cholesterol
Smoking	Reinforce cessation	Reinforce cessation	Reinforce cessation; pharmacological therapy and formal smoking cessation programs as appropriate
Exercise	Education	Hallway ambulation	Recommend regular aerobic exercise

*The ACC/AHA Class of Recommendation for the therapies listed in this table is *Class I.*