Update on Acute Coronary Syndromes: STEMI

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Objectives: STEMI

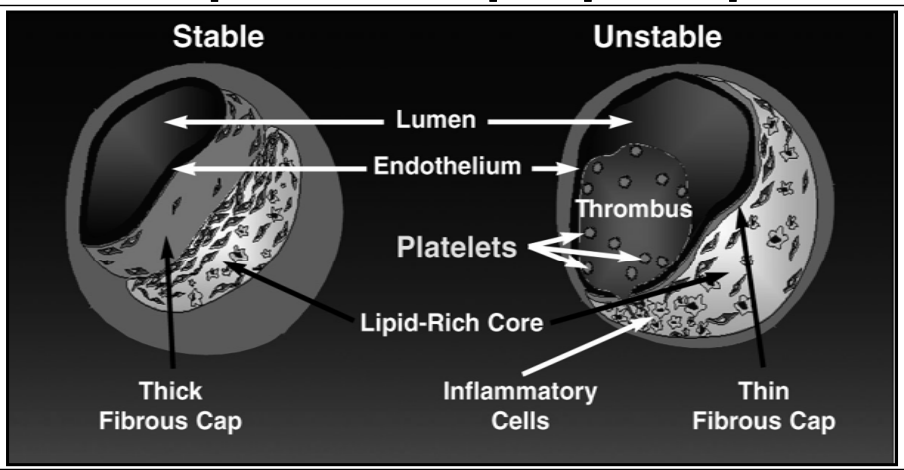
- **Introduction to ACS/STEMI**
  - ✓ **Definitions and Pathophysiology**
  - ✓ **Demographics and Reperfusion Data**
  - ✓ **2009 ACC/AHA STEMI Guideline Update**
- **STEMI Cases**
  - ✓ **ED Activation**
  - ✓ **Transfer Hospital Activation**
  - ✓ **EMS Activation**
- **Conclusions & Recommendations**

Definitions…

- **Acute Coronary Syndrome (ACS)**
  - ✓ ***Includes*** **STEMI, NSTEMI, UA**
- **Percutaneous Intervention (PCI)**
  - ✓ **Coronary angioplasty or stenting**
- **Definitions Specific to STEMI's**
  - ✓ **Primary PCI (PPCI)**
    - **Mechanical reperfusion with percutaneous coronary intervention for STEMI**
  - ✓ **Door-to-Balloon time (D2B)**
    - **ED arrival to cath lab balloon inflation or thrombectomy**
  - ✓ **Door-to-Door-to-Balloon time (D2D2B)**
    - **Non-PCI hospital ED to PCI hospital balloon**

Pathogenesis of STEMI

The vulnerable plaque and consequences of plaque rupture



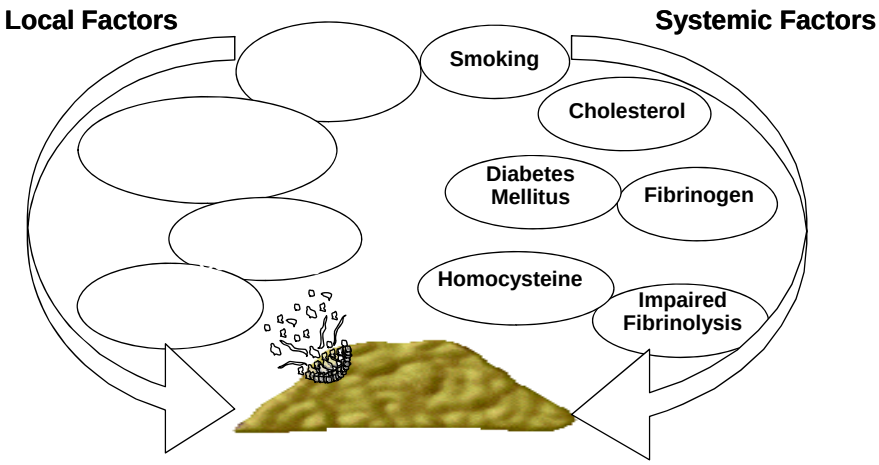
Adapted from Falk E, et al. Circulation. 1995;92:657-671.

Pathogenesis of STEMI

The vulnerable plaque and consequences of plaque rupture

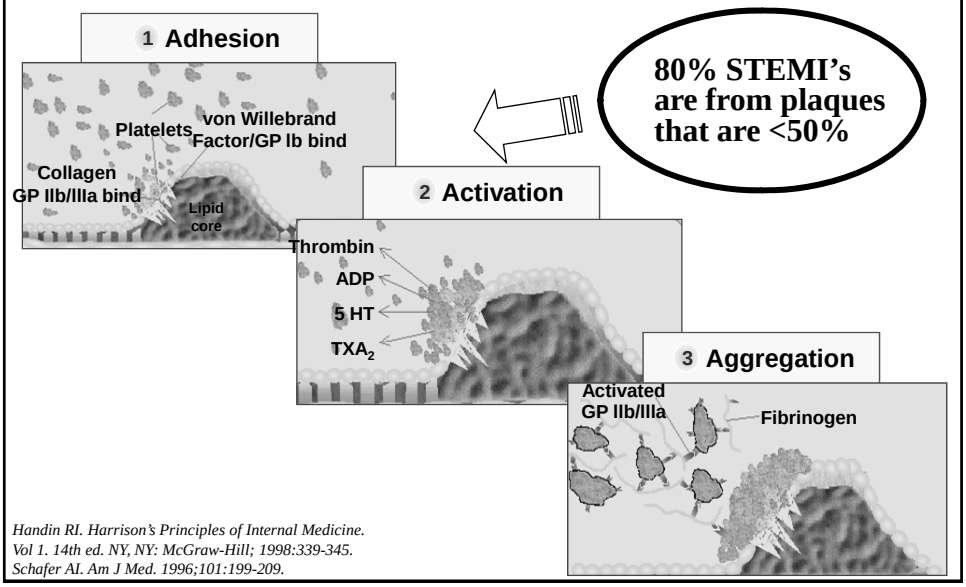
- **The majority of STEMI's originate from atherosclerotic plaques of <50%**
  - ✓ **A result of ruptured plaque with subsequent thrombus formation and acute vessel occlusion**
    - **Foam cells (macrophages that contain lipid) at the margins of small plaques contribute to plaque rupture by secreting metalloproteinases that eat through the fibrous cap**
    - **Creates caps called "thin-cap fibroatheroma" with cap thickness less than 65 µM (TCFA)**

Risk Factors for Plaque Rupture



Fuster V, et al. N Engl J Med. 1992;326:310-318.
Falk E, et al. Circulation. 1995:92:657-671.

Platelet Cascade in Thrombus Formation



80% STEMI's are from plaques that are <50%

Handin RI. Harrison's Principles of Internal Medicine. Vol 1. 14th ed. NY, NY: McGraw-Hill; 1998:339-345.
Schafer AI. Am J Med. 1996;101:199-209.

Mount St Helens, Washington
USA
May 18, 1980

Hospital Discharges for ACS: The Scope of the Problem

Acute Coronary Syndrome

1.68 Million Hospital Discharges ACS

UA/NSTEMI

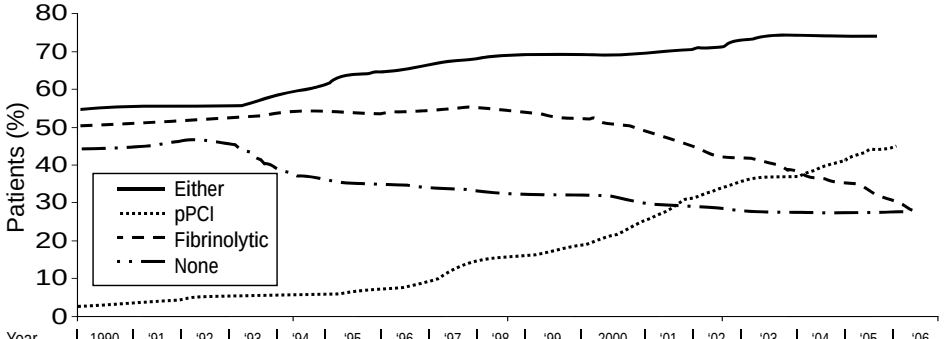
1.32 million
Discharges per Year

STEMI

360,000
Discharges per Year

AHA Heart and Stroke Facts 2004.
Based on 2001 National Hospital Discharge Survey:US Dept of Health and Human Services.

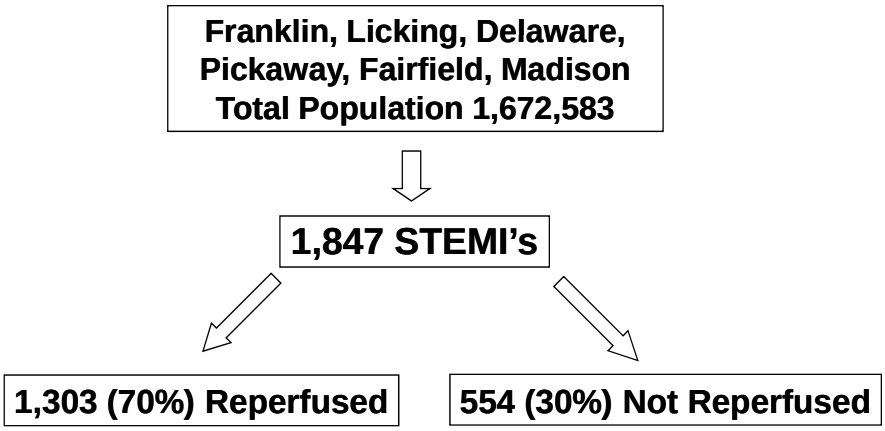
Trends in STEMI Reperfusion: NRMI 1990-2006



Year	1990	'91	'92	'93	'94	'95	'96	'97	'98	'99	2000	'01	'02	'03	'04	'05	'06
Either	55.1	54.8	53.7	57.1	60.7	62.5	62.9	64	64.3	65.5	66.6	68.2	69.3	69.2	68.6	71.3	70.8
pPCI	2.6	2.1	2.4	3.6	6.4	9.2	10.9	12.2	13.7	15.3	17.2	20	23.3	29.6	34.1	38.9	43.2
Fibri-nolytic	52.5	52.7	51.3	53.5	54.3	53.3	52	51.8	50.6	50.2	49.4	48.2	46	39.6	34.5	32.4	27.6
None	44.9	45.1	46.3	42.8	38.9	36.5	36.3	35.2	34.8	33.5	32.5	31.1	29.9	29.9	29.9	27.4	28.1

Slide Courtesy of DJ Kereiakes, Lindner Heart Center; Gibson et al. Am Heart J 2008;156:1035

Central Ohio Overview: The Scope of the Problem (2006 Estimates)



AHA Mission Lifeline Estimates; 2006 Annual Ohio Inpatient Price Disclosure Report, Ohio Hospital Association

STEMI Keys to Success

- **Prompt diagnosis is critical**
  - ✓ **Patient Education, EMS Education, Regional STEMI systems of care**
- **Time to reperfusion is the critical component of STEMI's**
- **Expeditious movement towards revascularization is critical**
  - ✓ **Primary PCI (within 90 minutes)**
  - ✓ **Thrombolytics (within 30 minutes)**

Guideline Based Approach to STEMI?

AHA Scientific Statement

2009 Focused Updates: ACC/AHA Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction (Updating the 2004 Guideline and 2007 Focused Update) and ACC/AHA/SCAI Guidelines on Percutaneous Coronary Intervention (Updating the 2005 Guideline and 2007 Focused Update)

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Frederick G. Kushner, MD, FACC, FAHA, FSCAI, Co-Chair; Mary Hand, MSPH, RN, FAHA, Co-Chair*; Sidney C. Smith, Jr, MD, FACC, FAHA, Chair; Spencer B. King III, MD, MACC, FSCAI, Co-Chair; Jeffrey L. Anderson, MD, FACC, FAHA; Elliott M. Antman, MD, FACC, FAHA; Steven R. Bailey, MD, FACC, FSCAI; Eric R. Bates, MD, FACC, FAHA; James C. Blankenship, MD, FACC, FSCAI; Donald E. Casey, Jr, MD, MPH, MBA; Lee A. Green, MD, MPH; Judith S. Hochman, MD, FACC, FAHA; Alice K. Jacobs, MD, FACC, FAHA, FSCAI; Harlan M. Krumholz, MD, SM, FACC, FAHA; Douglass A. Morrison, MD, PhD, FACC, FSCAI; Joseph P. Ornato, MD, FACC, FAHA; David L. Pearle, MD, FACC, FAHA; Eric D. Peterson, MD, MPH, FACC, FAHA; Michael A. Sloan, MD, MS, FACC, FAHA; Patrick L. Whitlow, MD, FACC, FAHA; David O. Williams, MD, FACC, FAHA, FSCAI

Applying Classification of Recommendations and Level of Evidence

Class I	Class IIa	Class IIb	Class III
Benefit >>> Risk	***Benefit >> Risk Additional studies with focused objectives needed***	***Benefit ≥ Risk Additional studies with broad objectives needed; Additional registry data would be helpful***	***Risk ≥ Benefit No additional studies needed***
Procedure/ Treatment SHOULD **be performed/ administered**	IT IS REASONABLE **to perform procedure/administer treatment**	**Procedure/Treatment** MAY BE CONSIDERED	**Procedure/Treatment should** NOT **be performed/administered** SINCE IT IS NOT HELPFUL AND MAY BE HARMFUL

Level A:	**Recommendation based on evidence from multiple randomized trials or meta-analyses Multiple (3-5) population risk strata evaluated; General consistency of direction and magnitude of effect**
Level B:	**Recommendation based on evidence from a single randomized trial or non-randomized studies Limited (2-3) population risk strata evaluated**
Level C:	**Recommendation based on expert opinion, case studies, or standard-of-care Very limited (1-2) population risk strata evaluated**

2007: STEMI Reperfusion

I	IIa	IIb	III
A			

STEMI patients presenting to a hospital with PCI capability should be treated with primary PCI within 90 minutes of *first medical contact.*

Modified recommendation

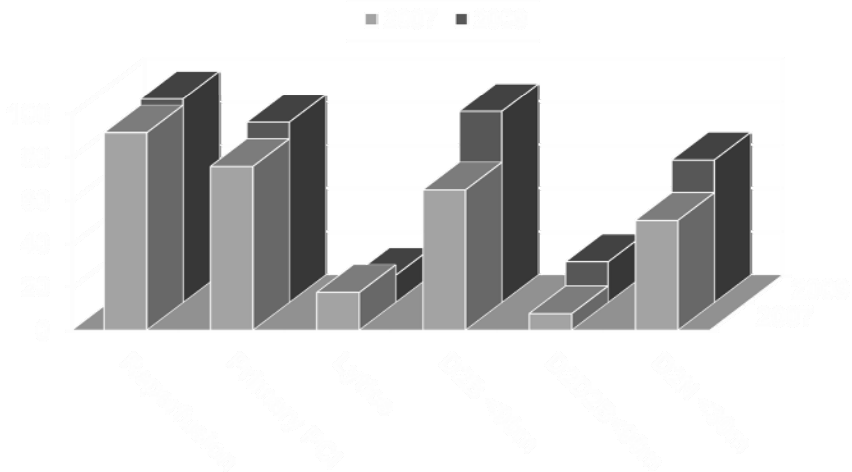
I	IIa	IIb	III
B			

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

Modified recommendation

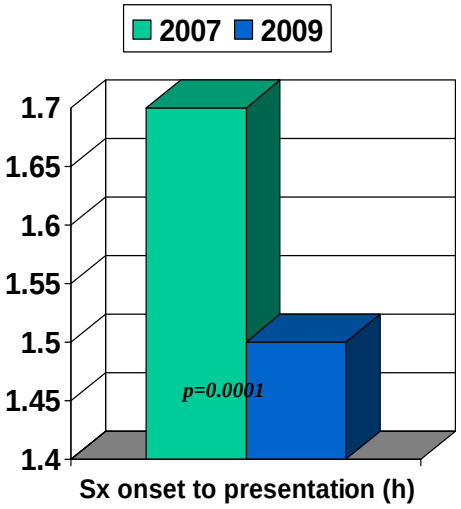
2007 Focused Update of the ACC/AHA Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction

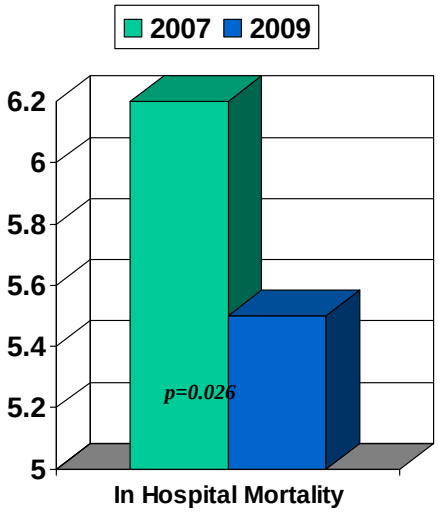
Action Registry 2007 vs 2009



Roe et al. JACC, 56(4), 2010:254-63

Action Registry 2007 vs 2009





Roe et al. JACC, 56(4), 2010:254-63

STEMI Reperfusion "Trauma of the Heart"

Photo Courtesy of MedFlight of Ohio

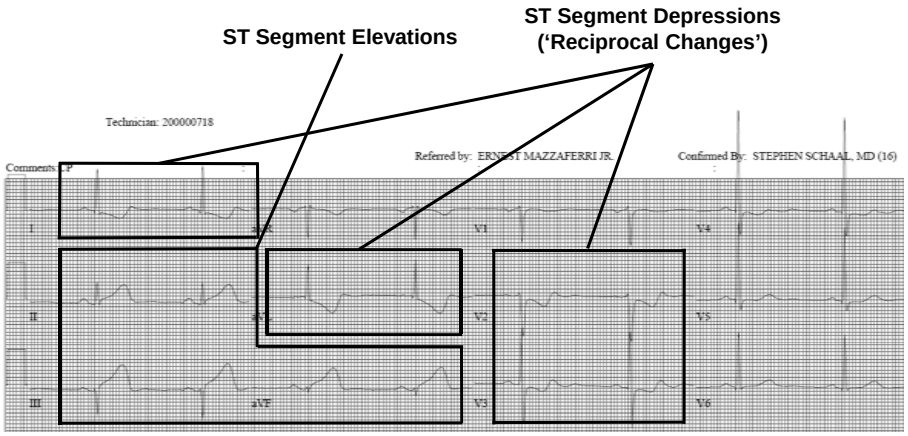
CASE 1: Emergency Department Activation Does D2B Time Matter?

- **66yo WM with only hx of a DVT 40 years ago, presents to ED with 90 min of substernal 'fullness' that radiates to his jaw and is associated with weakness, nausea, and diaphoresis.**
  - **Interestingly, he noted a slower than normal HR.**
- **Patient placed in treatment room and ED team assembles.**
  - **Staff obtains 12 lead EKG, provides oxygen, and establishes IV access.**
  - **ED physician performs rapid, focused assessment.**

Rapid and Focused HPI/Exam

- ***Chest Discomfort* – (be brief)**
  - ✓ **Onset, Description, Associated Sx's, Precipitating Factors**
- ***Alternate Diagnosis***
  - ✓ ***Aortic Dissection!!!!***
    - **Severe *tearing* pain radiating to the back, may be pulsatile**
    - **Dissection may extend into pericardium causing effusion/tamponade or disrupt coronary ostium**
  - ✓ **PTX, Esophageal Rupture, PE, Cardiac Tamponade**
  - ✓ **Listen for AI, JVD, Lungs, pulses in all 4 extremities, etc**
  - ✓ **If suspicious: Check BP in both arms, consider imaging (CXR, CTA)**
- ***Assess Bleeding Risk***
  - ✓ **Assess if previous bleeding ulcers, melena, CVA's**
  - ✓ **Recent Ischemic Stroke or Cerebrovascular Hemorrhage**
- ***Assess Drug use – specifically cocaine***

Emergency Department Activation



Inferior STEMI

Emergency Department Activation

- ***ASA 324 mg (chewed)***
- ***Heparin Bolus 60u/kg bolus (max 4000u)***
- ***Clopidogrel 600mg PO x 1***
- **IV pressors/fluids, airway protection as needed**
- **Analgesia: Does patient need a nitro drip?**
- ***Transport directly to Cath lab!***

TIMI Study Group (TIMI-2): *N Engl J Med* 1989;320:618-27.
2007 ACC/AHA Practice Guideline Update

STEMI Analgesia

Morphine sulfate is the analgesic of choice for STEMI-associated pain management

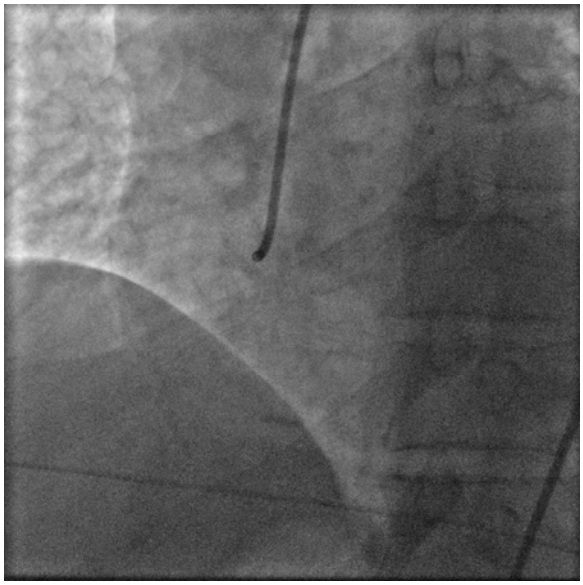
Intravenous nitroglycerin is indicated for relief of *ongoing ischemic discomfort, control of hypertension or management of pulmonary congestion*

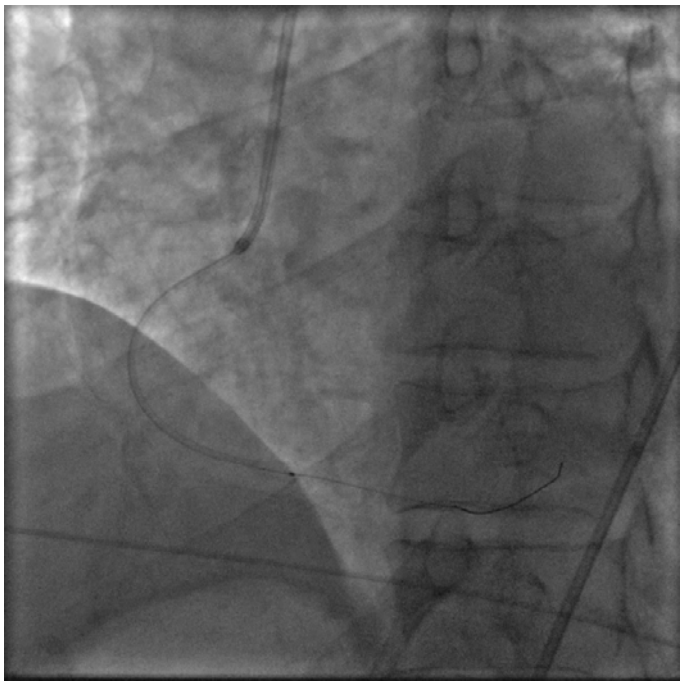
Nitrates SHOULD NOT be administered if:

1) SBP <90 (or 30mmHg less than baseline)
2) severe bradycardia (<50) or tachycardia (>100)
3) suspected RV infarction, or
4) in patients receiving viagra/cialis within 24-48 hours

2007 ACC/AHA Practice Guideline Update

Emergency Department Activation

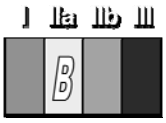




Thrombectomy: Export Catheter

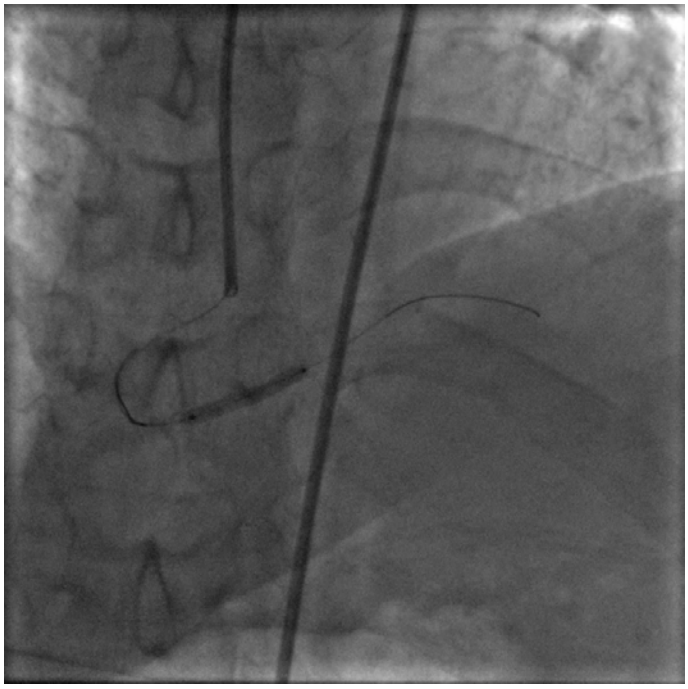
Thrombectomy Primary PCI

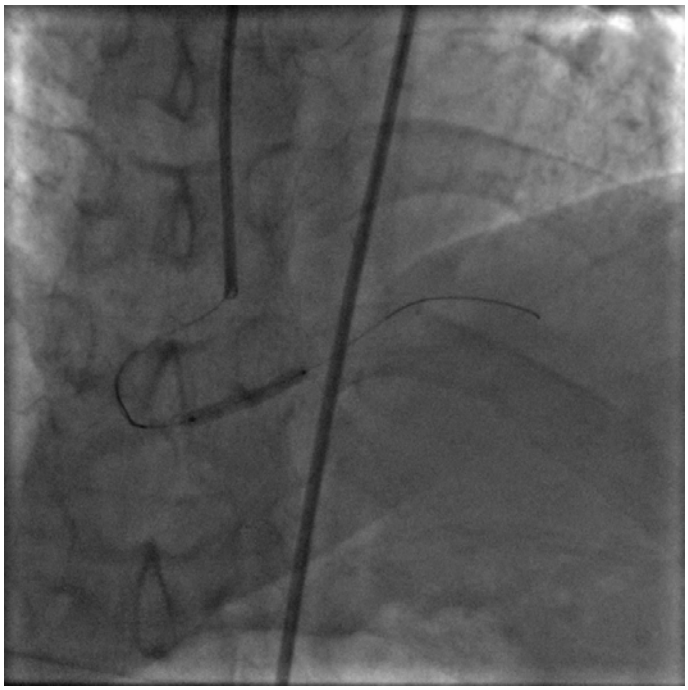
2009 Modified Recommendation

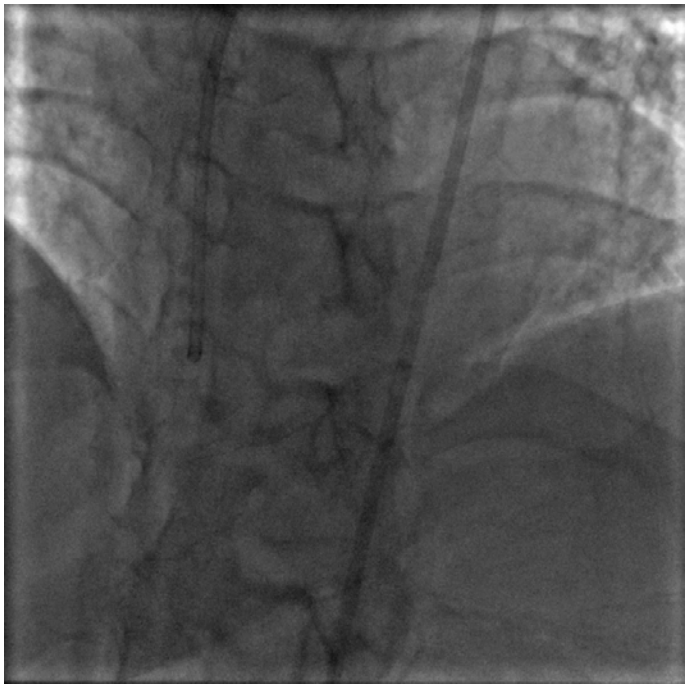


Aspiration thrombectomy is reasonable for
patients undergoing primary PCI
(*Level of Evidence: B*)

2009 ACC/AHA Practice Guideline Update

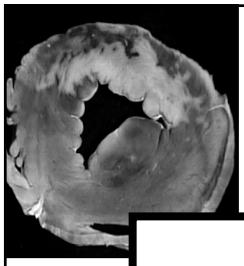




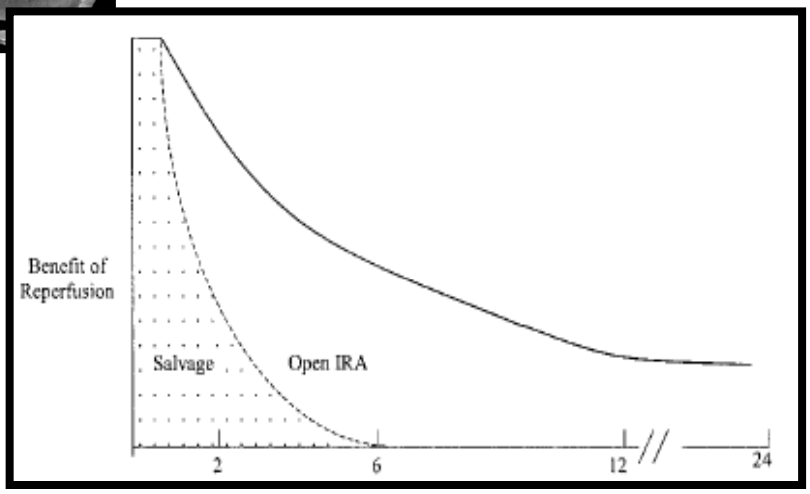


Emergency Department Activation

- **Culprit Lesion: 100% Distal RCA occlusion**
- **Intervention: Angioplasty and stent**
- **Door to Balloon time: 54 minutes**
- **Ejection Fraction: 60% by ECHO, normal**
- **Peak Troponin 89.04**
- **Discharged on Hospital Day #3**

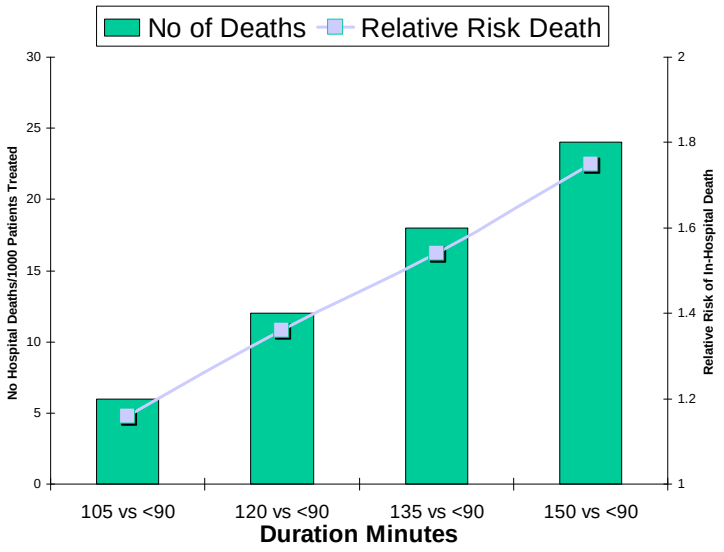


"The Golden Hour(s)"



Giugliano & Braunwauld. Circulation 2003;108:2828-2830

STEMI Patients: Time Matters

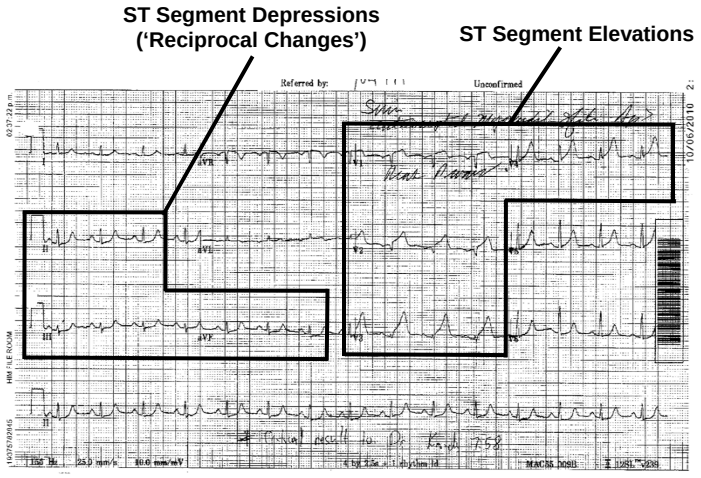


Nallamothu et al. N Engl Journ Med 2007;357:1631-8.

Case 2: Hospital Transfer Thrombolytics vs Primary PCI?

- **65yo WF with hx of HLD, presented to OSH after waking with 'light' chest pain felt diffusely through her precordium. Associated with an 'unsettling feeling'. Within 30 minutes, the pain intensified and began radiating into her left shoulder/arm. Called 911, EMS transported patient to nearest ED.**
- **Patient placed in treatment room and ED team obtained 12 lead EKG, provided oxygen, and established IV access**
- **Rapid and focused assessment by ED Physician.**

Hospital Transfer



Anterolateral STEMI

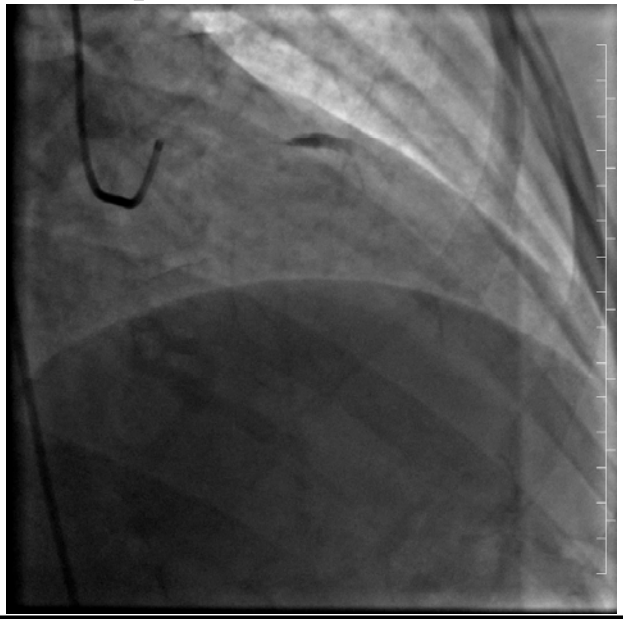
Hospital Transfer

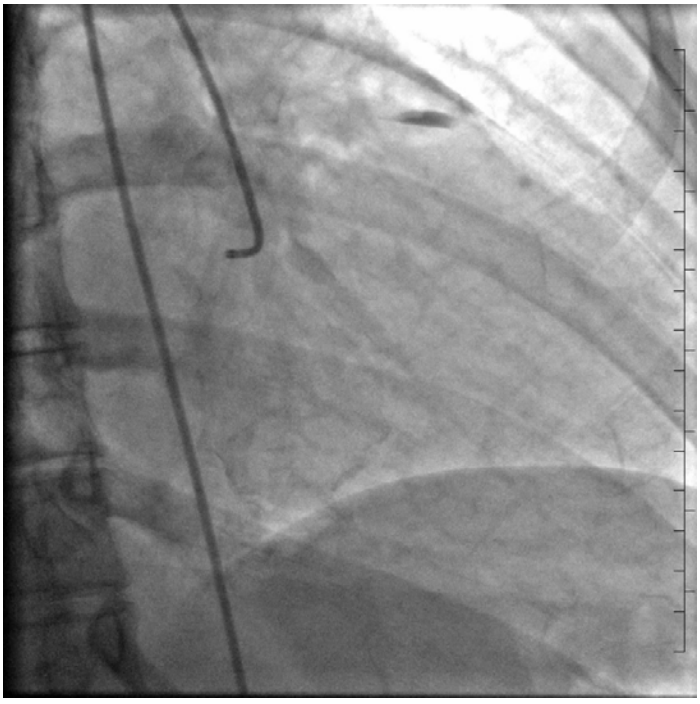
- **Contacted OSUMC Cardiology to facilitate direct transfer to OSU Cath' lab.**
  - ✓ **Arranged for expedient EMS transport to OSUMC**
- **ASA 324 mg (chewed)**
- **Heparin Bolus 60u/kg bolus (max 4000u)**
- **Plavix 600mg PO x 1**
- **<u>No Drip Protocol</u>**
  - ✓ **No evidence to support upstream IIb/IIIa administration**
  - ✓ **Delays transfer**
- **IV pressors/fluids, morphine, airway protection as needed**
- **Consider: Half dose lytics in selected patients**

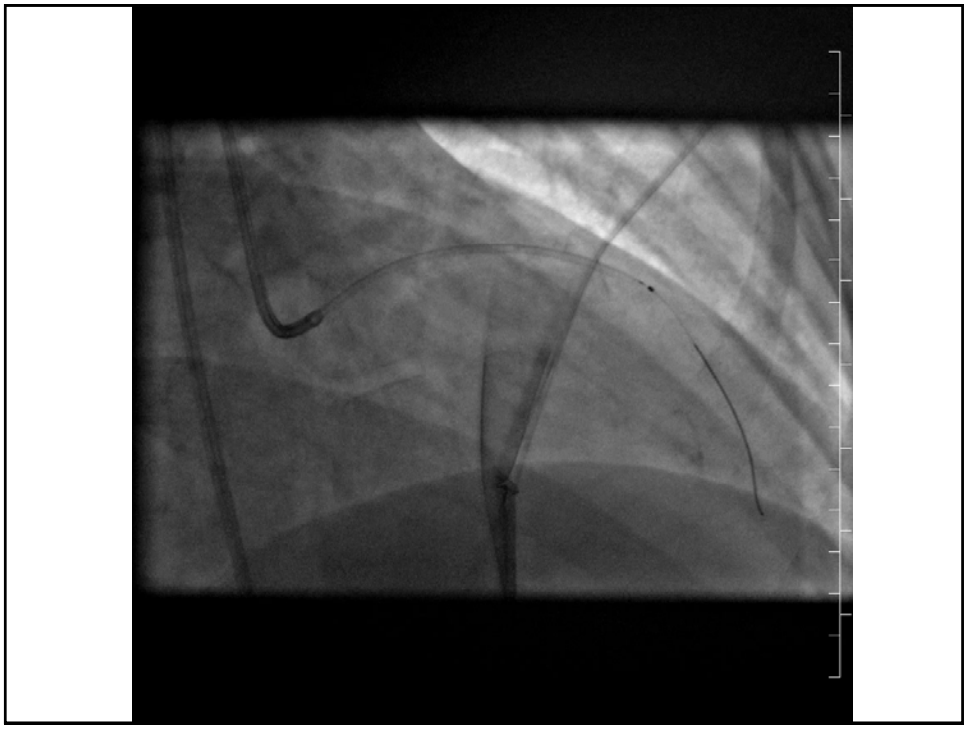
TIMI Study Group (TIMI-2): N Engl J Med 1989;320:618-27.

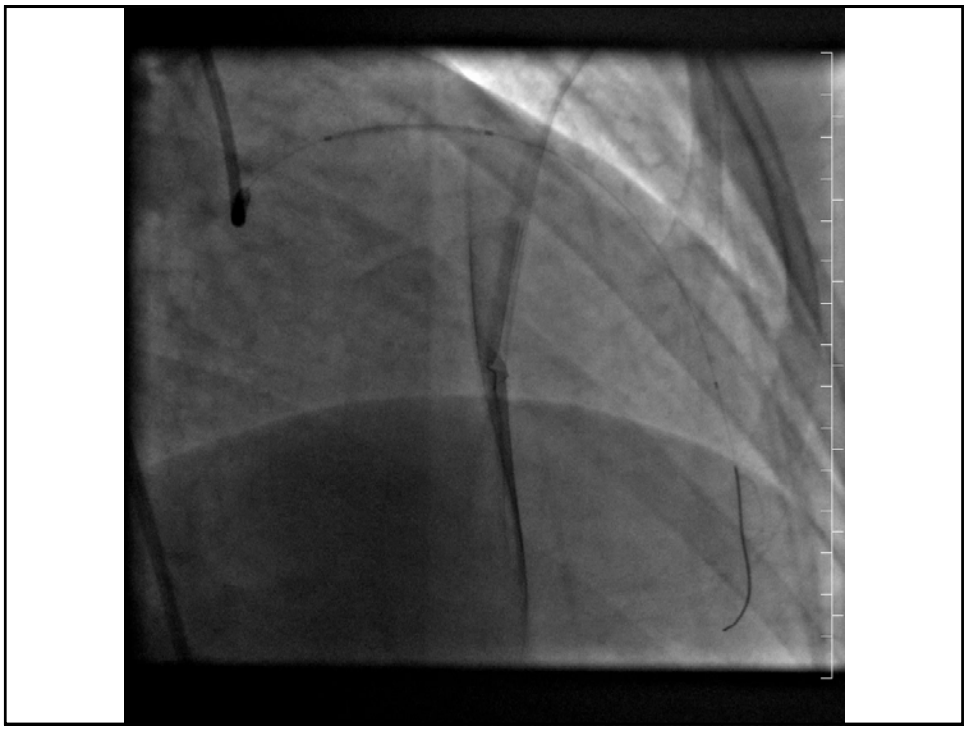
2009ACC/AHA Practice Guideline Update

Hospital Transfer







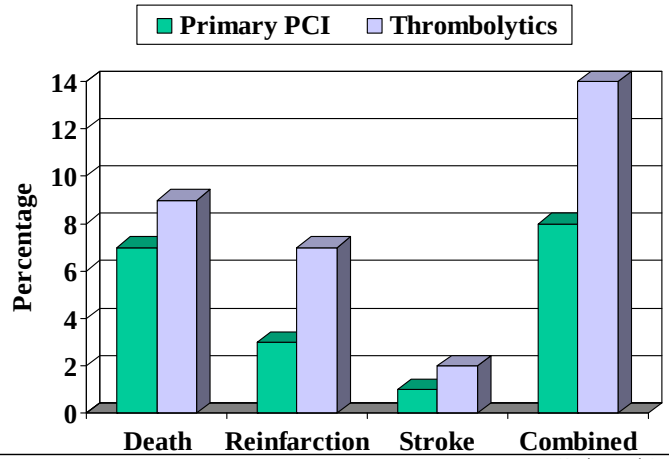


Hospital Transfer

- Culprit Lesion: 100% Proximal LAD occlusion
- Intervention: Thrombectomy, angioplasty and stent
- Door to Door to Balloon time: 86 minutes
- Ejection Fraction: 48% by ECHO
- Peak Troponin 147.93
- Discharged on Hospital Day #3

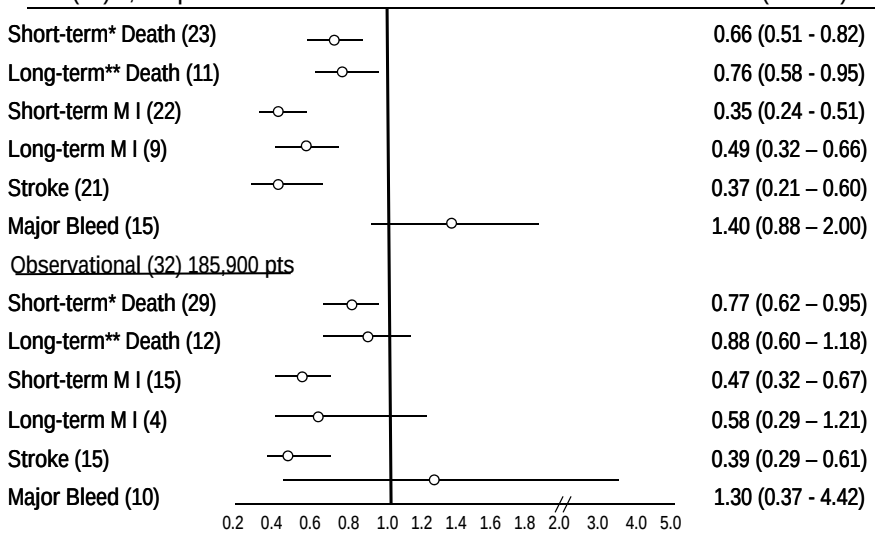
Thrombolytics vs Primary PCI

- 3872 Primary PCI vs 3867 Thrombolytics (29 trials)
  - ✓ Stents in 12 trials, GP IIbIIIa Inhibitors in 8 (ie Integrilin)



Keeley et al. Lancet 2003;361:13-20

Primary PCI vs. Fibrinolytic Therapy: Bayesian Hierarchical Meta-analysis of All Trials



Huynh, Theroux et al. Circ 2009;119:3101
Slide Courtesy of DJ Kereiakes; The Lindner Center

2007: STEMI Reperfusion

I IIa IIb III
A

STEMI patients presenting to a hospital with PCI capability should be treated with primary PCI within 90 minutes of *first medical contact.*

Modified recommendation

I IIa IIb III
B

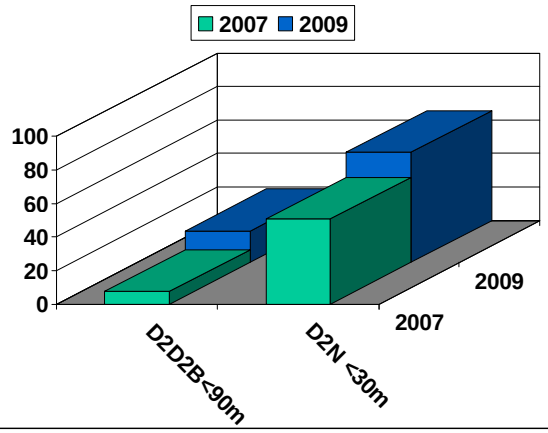
STEMI patients presenting to a hospital without PCI capability and who cannot be transferred to a PCI center for intervention **within 90 minutes of first medical contact** *should be treated with fibrinolytic therapy within 30 minutes* **of hospital presentation, unless contraindicated.**

Modified recommendation

2007 Focused Update of the ACC/AHA Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction

Action Registry 2007 vs 2009

- 81.3% of patients D2D2B > 90 minutes
- 35.4% of patients D2N > 30 minutes



Roe et al. JACC. 56(4). 2010:254-63

2009: Recommendations for Triage and Transfer for PCI (for STEMI)

2009 NEW Recommendation

I	IIa	IIb	III
	B		

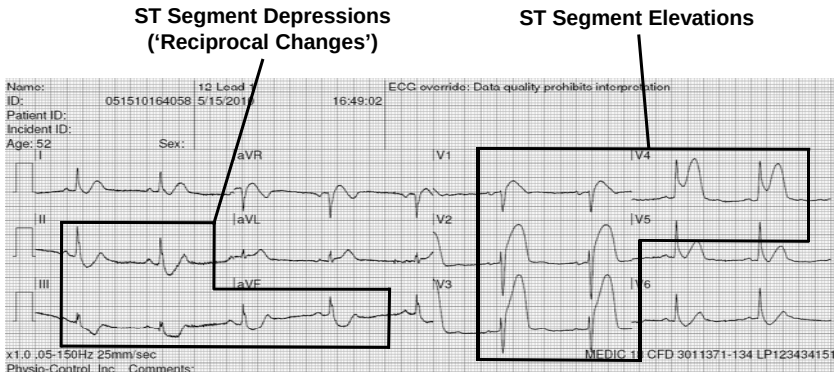
It is reasonable to transfer high risk patients who receive fibrinolytic therapy as primary reperfusion therapy at a non-PCI capable facility to a PCI-capable facility as soon as possible where *either PCI can be performed when needed or as a pharmacoinvasive strategy.*

2009 ACC/AHA Practice Guideline Update

Case 3: Field Activation
True First Medical Contact

- **52yo AAM with no PMHx noted acute onset of dyspnea, fatigue, diaphoresis and bilateral shoulder pain while landscaping.**
- **Co-workers transported him to local firehouse, Columbus Fire Medic 18, for assistance.**
- **Medics rapidly assessed the patient. Noting his respiratory distress, they immediately provided oxygen and obtained a 12 lead EKG.**

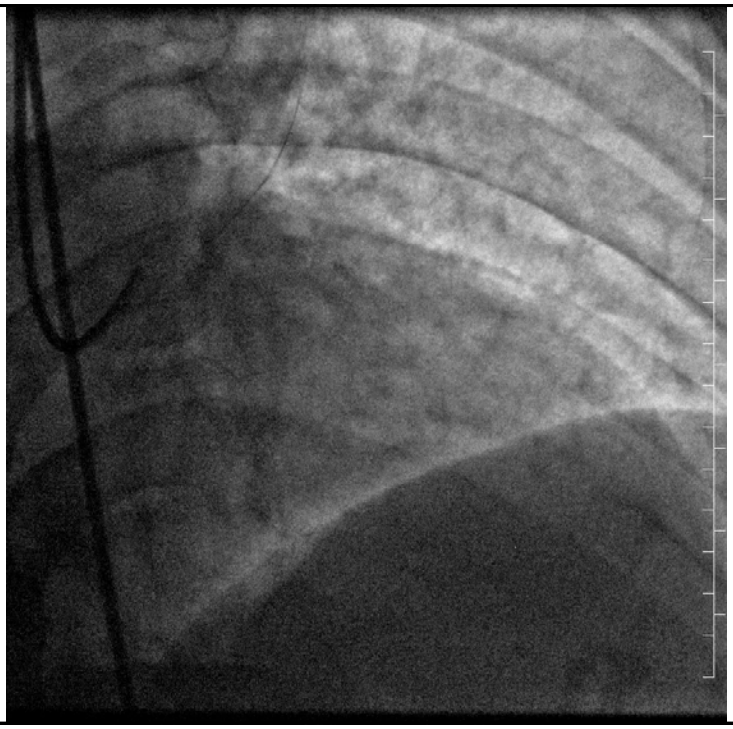
Field Activation

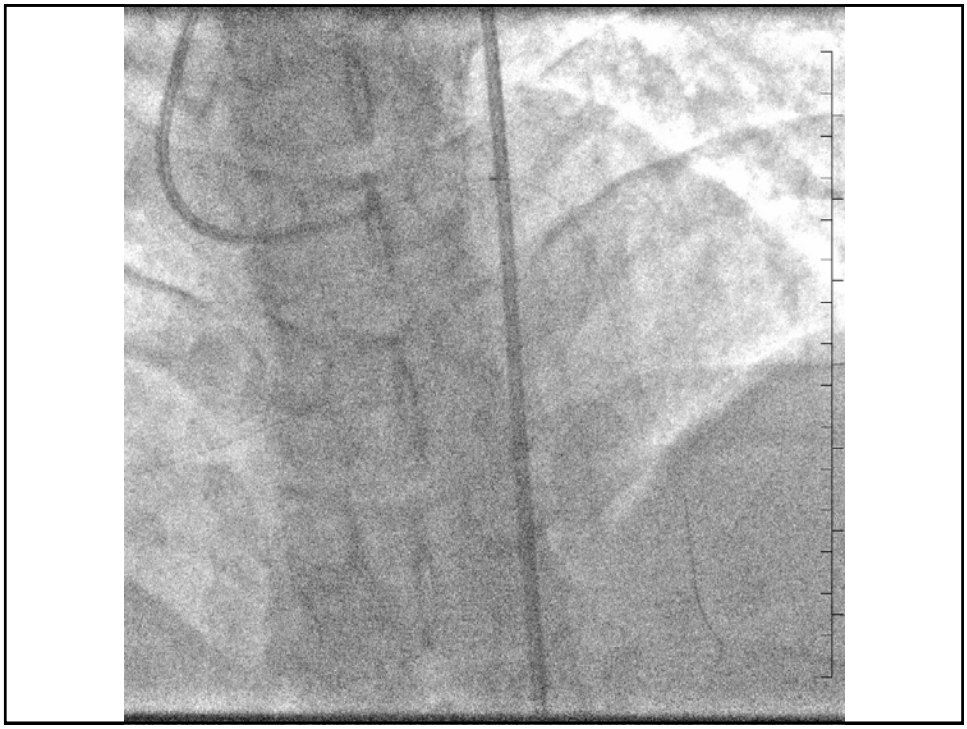


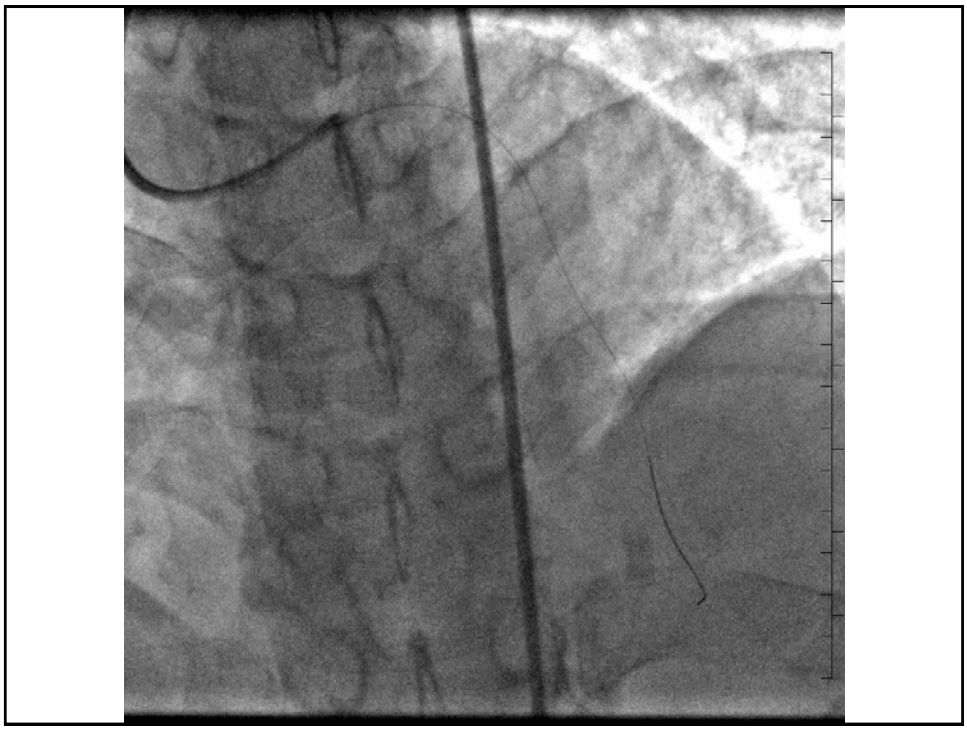
Anterolateral STEMI

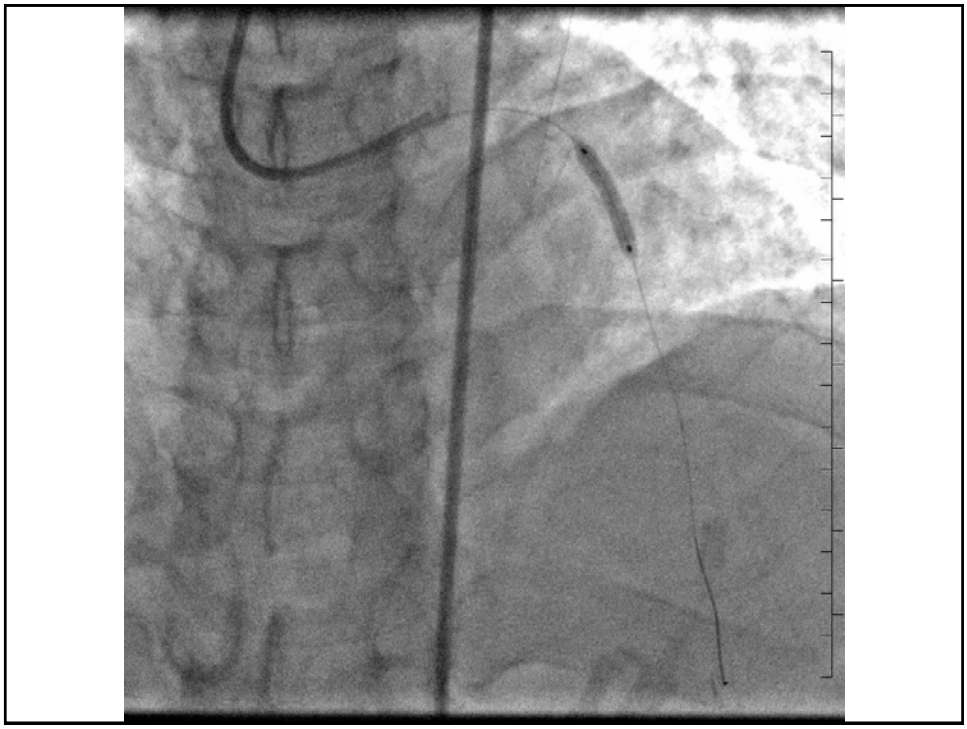
Field Activation

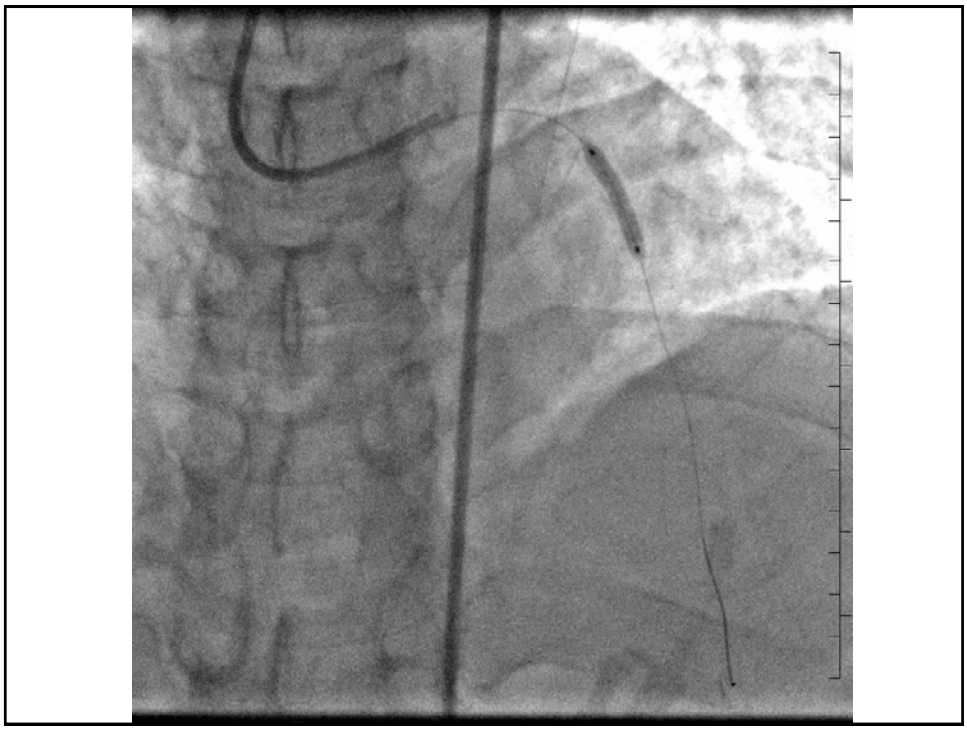
- **Medic 18 rapidly went into action:**
  - **Initated transport and transmitted 12 lead EKG.**
  - **Requested activation of the OSU cath' lab.**
  - **Established IV access and administered ASA/NTG.**
- **Cath' team had assembled to meet M18 upon arrival.**
- **Patient experienced multiple episodes of VF upon arrival to OSU and during catheterization, all successfully defibrillated.**

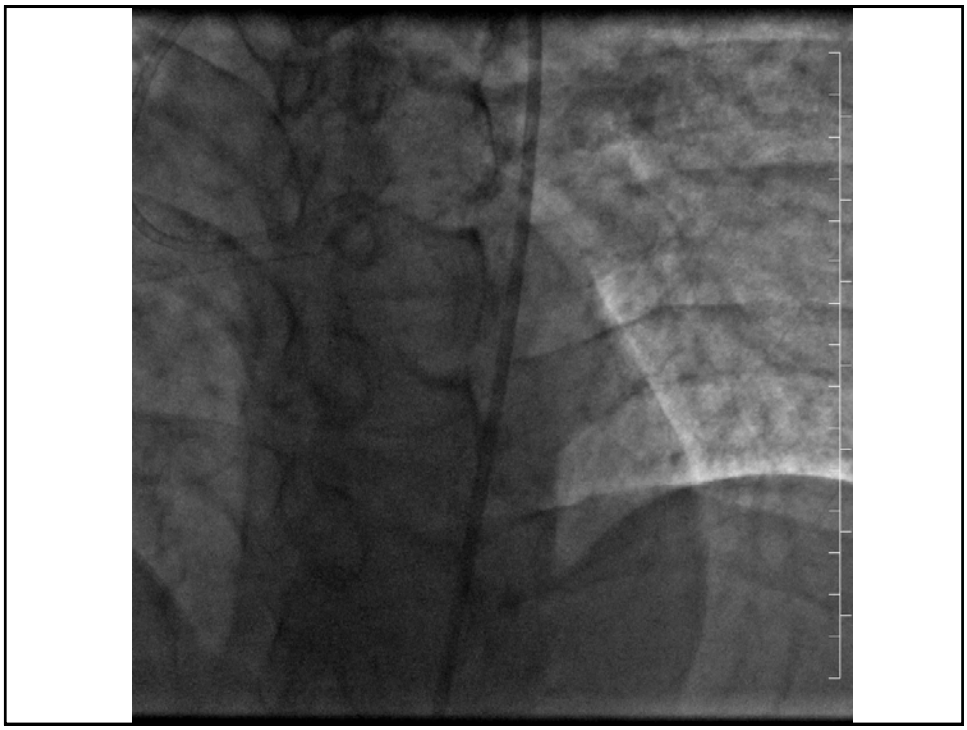


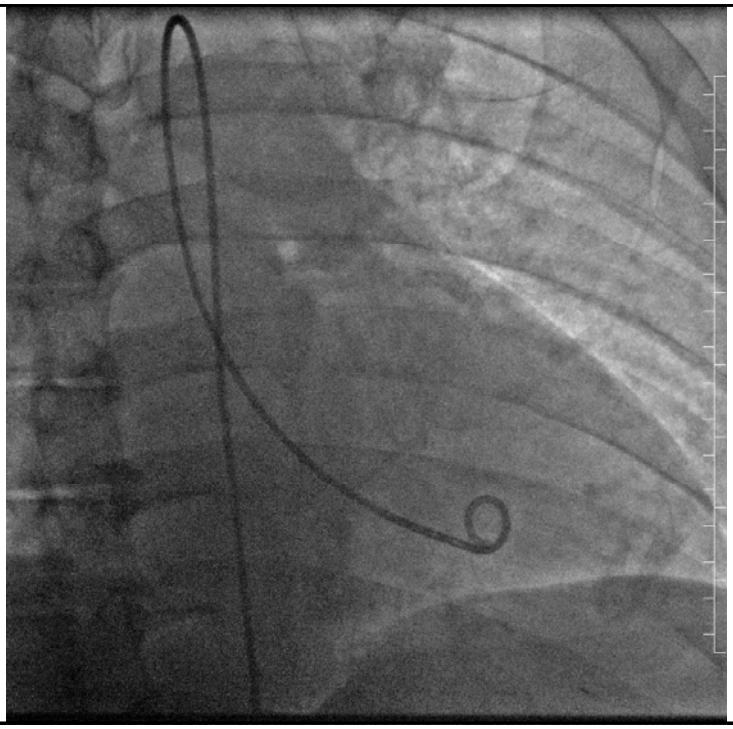










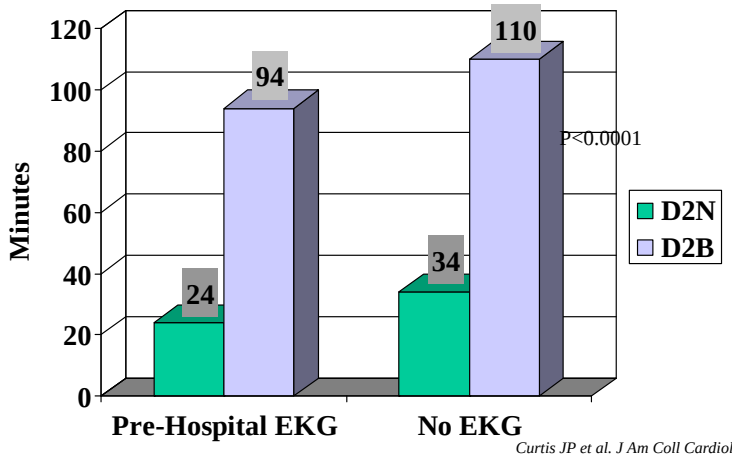


Field Activation

- **Culprit Lesion: 100% Proximal LAD occlusion**
- **Intervention: Thrombectomy, angioplasty and stent**
- **Door to Balloon time: 20 minutes**
- **Ejection Fraction: 73% by ECHO, normal**
- **Peak Troponin 20.25**
  - **For STEMI, minimal increase**
- **Discharged on Hospital Day #3**

Importance of Pre-Hospital EKG: National Registry of Myocardial Infarction-4 (NRMI-4) Database 2000-2002

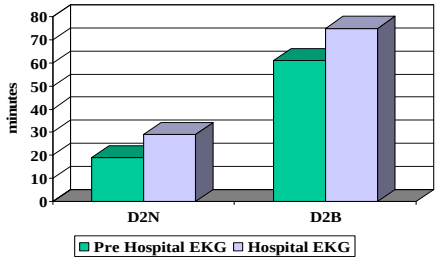
- 35,370 Patient in Fibrinolytic Cohort (4% received Pre-hospital EKG's)
- 21,277 Patients in Primary PCI Cohort (8% received Pre-hospital EKG's)
- Percentages increased yearly during the evaluation

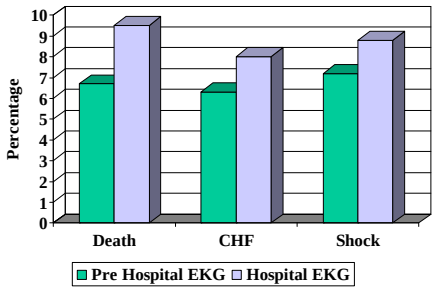


Curtis JP et al. J Am Coll Cardiol 2006;47:1544-52

Importance of Pre-Hospital EKG: ACTION Registry

- 12,097 STEMI patients in 2007
- 59% of STEMI patients utilized EMS
- 27% had pre hospital 12 lead EKG

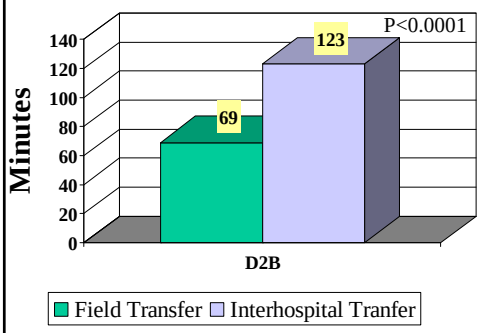


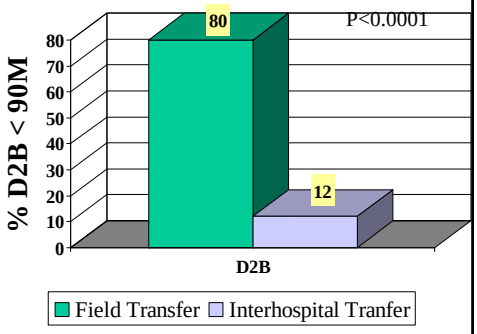


Diercks DB et al. J Am Coll Cardiol 2009;53:161-6

Field Transfer vs ED Transfer
Should Non-PCI Hospitals be bypassed?

- **May 2005 – April 2006**
- **344 Consecutive Pt for Primary PCI**
  - ✓ **135 directly from field vs 209 from Non-PCI Capable ED's**





Le May MR, NEJM 2008;358:231-40

STEMI Outcome

Activation Type	D2B Time	Peak Troponin	Ejection Fraction	Length of Stay
Field	20 min	20.25 ng/mL	73%	3 days
ED	54 min	89.04 ng/mL	60%	3 days
Hospital Transfer	86 min	147.93 ng/mL	48%	3 days

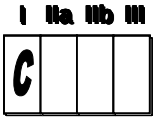
Conclusions/Recommendations

- **Approximately 80% of STEMI's come from plaques that are < 50%**
- **Time to reperfusion is critical in STEMI**
- **Rapid diagnosis and triage and recognition is critical**
  - ✓ **EMS Education, 12-lead EKG transmission**
- **STEMI Systems of care key to success**
  - ✓ **Multidisciplinary effort**
- **Primary PCI, when available within 90 minutes, is the preferred therapy over thrombolytics**

Recommendations for the use of Thienopyridines

2009 MODIFIED Recommendation

A loading dose of thienopyridine is recommended for STEMI patients for whom PCI is planned. Regimens should be:



Clopidogrel at least 300 mg to 600mg† should be given as early as possible before or at the time of primary or non-primary PCI.

2009 ACC/AHA Practice Guideline Update

Recommendations for the use of Thienopyridines

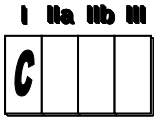
- **† The optimal loading dose of clopidogrel has not been established**
- **Randomized clinical trials using >300mg of clopidogrel as a loading dose for PCI in STEMI or UA/NSTEMI have not rigorously established superior safety or efficacy**
- **Clopidogrel is a pro-drug which must undergo hepatic conversion to its active metabolite for platelet inhibition:**
  - ✓ ***75 mg daily dosing takes 5 days to peak concentration***
  - ✓ ***300mg load takes ~ 5 hours to peak concentration***
  - ✓ ***600mg load takes ~ 2 hours to peak concentration***

2009 ACC/AHA Practice Guideline Update

Recommendations for the use of Thienopyridines

2009 MODIFIED Recommendation

Prasugrel 60 mg should be given as soon as possible for primary PCI.

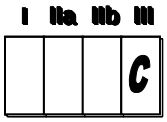


Clopidogrel at least 300 mg to 600mg† should be given as early as possible before or at the time of primary or non-primary PCI.

2009 ACC/AHA Practice Guideline Update

Thienopyridines

2009 NEW Recommendation



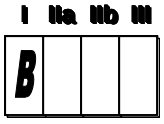
In STEMI patients with a prior history of stroke and transient ischemic attack for whom primary PCI is planned, prasugrel is not recommended as part of a dual antiplatelet therapy regimen

2009 ACC/AHA Practice Guideline Update

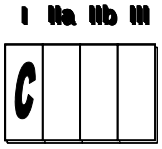
Use of Parenteral Anticoagulants in STEMI

2009 Modified Recommendation

For patients proceeding to primary PCI, who have been treated with ASA and a thienopyridine, recommended supportive anticoagulant regimens include:



Bivalirudin is useful as support for primary PCI with or without prior treatment with heparin.



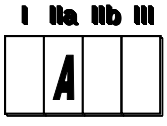
For prior treatment with UFH, additional boluses of UFH should be administered as needed to maintain therapeutic activated clotting time levels, taking into account whether GP IIb/IIIa receptor antagonists have been administered

2009 ACC/AHA Practice Guideline Update

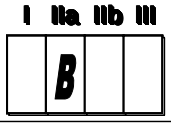
Use of Glycoprotein IIb/IIIa Receptor Antagonists in STEMI

2009 Modified Recommendation

It is reasonable to start treatment with glycoprotein IIb/IIIa receptor antagonists at the time of primary PCI (with or without stenting) in selected patients with STEMI:



abciximab



tirofiban and eptifibatide

2009 ACC/AHA Practice Guideline Update

Use of Glycoprotein IIb/IIIa Receptor Antagonists in STEMI

2009 Modified Recommendation

I	IIa	IIb	III
		B	

The usefulness of glycoprotein IIb/IIIa receptor antagonists (as part of a preparatory pharmacologic strategy for patients with STEMI prior to arrival in the cardiac catheterization laboratory for angiography and PCI) is uncertain.

2009 ACC/AHA Practice Guideline Update