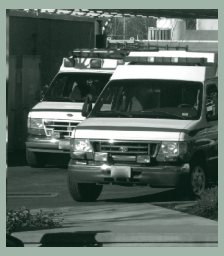
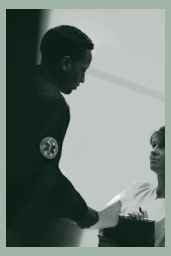
Recommendations for

The Early Management of Adults with ST-Elevation Myocardial Infarction (STEMI)





Because heart disease is the leading cause of death and long-term disability in California.

Prepared by

The STEMI Systems Work Group, 2010

Co-sponsored by:

The American Heart Association/American Stroke Association;
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The American College of Cardiology, California Chapter

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Table of Contents

- **List of Acronyms** 7
- **Introduction** 9
  - Preface 9
  - Mission 9
  - Background 9
  - Position Statements 11
  - Action 13
  - Summary of Recommendations 16
  - Challenges 20
  - Work Group and Disclosures 22
- **Prehospital STEMI Care** 27
  - Emergency Medical Dispatch 30
  - EMS Responders 32
  - Transport 34
  - Evaluation and Outcomes 38
- **Hospital Care** 41
  - SRC Criteria 45
  - SRF Criteria 47
  - Evaluations and Outcomes 49
- **Community STEMI Education** 53
- **STEMI System Implementation** 59
  - System Development 61
  - Systems and Settings 64
  - System Oversight 67
- **Appendices** 69
  - A: Fibrinolytic Checklist 71
  - B: Acute Coronary Syndrome Algorithm 73
  - C: Pre-Hospital Data Elements 75
  - D: Sample LEMSA STEMI Transfer Policy 77
  - E: Sample SRF Transfer Protocol 81
  - F: NCDR-ACTION Registry-GWTG 87
  - G: NCDR-ACTION Registry-GWTG (Limited) 93
  - H: Reasons Patients Delay 97
  - I: Map of PCI-Capable Hospitals 99
  - J: References 101

List of Acronyms

ACC	American College of Cardiology
ACE	Angiotensin-converting enzyme
AHA/ASA	American Heart Association/American Stroke Association
AMI	Acute myocardial infarction
ARB	Angiotensin receptor blocker
CAL/ACEP	California Chapter of the American College of Emergency Physicians
CDPH	California Department of Public Health
CHDSP	California Heart Disease and Stroke Prevention Program
CPR	Cardiopulmonary resuscitation
CQI	Continuous quality improvement
D2B	Door-to-Balloon time
ECG	Electrocardiogram
ED	Emergency Department
EMD	Emergency medical dispatcher
EMDAC	Emergency Medical Services Medical Directors Association of California
EMS	Emergency medical services
EMSAAC	Emergency Medical Services Administrators Association of California
EMT	Emergency medical technician
GPS	Global positioning system
LEMSA	Local Emergency Medical Services Agency
NAEMSP	National Association of Emergency Medical Service Physicians
NCDR ACTION	National Cardiovascular Data Registry - Acute Coronary Treatment and Intervention Outcomes Network
NDH	Non-designated hospital
PCI	Percutaneous coronary intervention
PH 12-lead -ECG	Pre-hospital 12-lead electrocardiogram
PSAP	Public Service Answering Point
SRC	STEMI-Receiving Center
SRF	STEMI-Referral Facility
STEMI	ST-elevation myocardial infarction
UTC	Coordinated universal time

Introduction

PREFACE

The ST-Elevation Myocardial Infarction (STEMI) Work Group (Work Group) was co-convened by the American Heart Association/American Stroke Association (AHA/ASA) and the California Heart Disease and Stroke Prevention (CHDSP) Program, California Department of Public Health (CDPH), under a provision of *California's Master Plan for Heart Disease and Stroke Prevention and Treatment*, adopted in 2007. The American College of Cardiology (ACC), California Chapter, which has been central to efforts to improve STEMI care in the state, joined AHA/ASA and CHDSP as a co-sponsor of this project.

MISSION

The mission of the Work Group was to reduce heart attack morbidity and mortality in California by:

- Establishing strategies for the development of a statewide system of STEMI care for adults over age 18, including: (1) recommendations for pre-hospital patient assessment and destination hospital determination for eligible STEMI patients; (2) criteria for the designation of STEMI-Receiving Centers; (3) criteria for the designation of STEMI-Referral Facilities; (4) criteria for transfer of STEMI patients; and (5) continuity of care through linkages between medical facilities.
- Providing guidance as STEMI systems of care are implemented in California.
- Promoting recovery from STEMI, including access to rehabilitation services.
- Promoting secondary prevention of STEMI, including smoking cessation and other risk reduction strategies.

BACKGROUND

Heart disease is the leading cause of death and long-term disability. In California, heart disease accounts for approximately 47,000 deaths each year, 134 deaths per 100,000 population.[1] In 2007, six percent of Californians reported a diagnosis of heart disease.[2] The annual cost of coronary heart disease in California is approximately $20 billion.[3]

A heart attack occurs when there is a severe reduction in blood flow to a segment of the heart muscle. Within minutes, irreversible heart muscle damage begins to occur. One type of heart attack is called an ST-elevation myocardial infarction (STEMI). This term refers to the specific pattern that is observed on an electrocardiogram (ECG). Approximately 30 percent of heart attacks in the United States are classified as STEMIs.[4] Less acute forms of blood vessel occlusion in the heart include non-STEMIs and unstable angina.

According to ACC/AHA clinical practice guidelines, the treatment strategy for a STEMI is to restore blood flow to the heart (reperfusion) as rapidly as possible to limit damage to the heart muscle. The goal is to limit total ischemic time (i.e., the amount of time that the heart muscle is without oxygen, measured from the time of onset of symptoms to the time of reperfusion) to less than 120 minutes.[5,6,7] Reperfusion can be accomplished either through the use of a medication that breaks up clots (fibrinolytic therapy) or by primary percutaneous coronary intervention (PCI). In PCI, a small balloon is inflated inside the artery to clear the blockage, and then a tube called a "stent" is inserted to keep the artery open. PCI (also known as angioplasty) must be performed in a hospital with a cardiac catheterization laboratory (cath lab) that has PCI capability; approximately 1,200 to 1,400 of the 2,200 cath labs in the United States are PCI-capable.[8] Research demonstrates that PCI, if performed in a timely fashion by an experienced clinician, is superior to fibrinolytic therapy for treating acute STEMI;[9] however, fibrinolytic therapy is more widely available.

Additionally, PCI is the only reperfusion option for STEMI patients who are not eligible for fibrinolytic therapy or do not respond to fibrinolytic therapy (approximately 20 to 25 percent of patients).[10] PCI is also the preferred therapy for patients who arrive for treatment with late signs or symptoms of STEMI and for those in heart failure and/or shock. High blood pressure (over 180/110 mm Hg),

recent stroke or head/facial trauma (within three months), recent surgery or major trauma (within six weeks), use of anticoagulants ("blood thinning" medications), pregnancy, or serious disease (advanced cancer or severe liver or kidney disease) may also make a patient ineligible for fibrinolysis.

Despite the wide availability of these two effective reperfusion treatments, about 30 percent of STEMI patients who could benefit do not receive either treatment and go on to suffer avoidable disability or death.[11] Of those patients who do receive fibrinolytic therapy, less than half are treated within the recommended 30-minute interval from hospital door to treatment.[12] Only 40 percent of those who undergo PCI receive treatment within the recommended 90-minute interval from arrival at the hospital door to procedure.[12] Clearly, there is much room for improvement in the timely treatment of STEMI.

POSITION STATEMENTS

Advocates for improved clinical outcomes following STEMI have recommended changes to the current medical system. Several organizations have provided position statements relating to the acute management of STEMI. These documents have provided guidance for the development and implementation of a statewide system of STEMI care for California.

AHA Conference Proceedings — Development of Systems of Care for ST-Elevation Myocardial Infarction Patients

In 2007, AHA Conference Proceedings were published on the Development of Systems of Care for ST-Elevation Myocardial Infarction Patients. These proceedings include an Executive Summary[13] and findings from the Conference Working Groups that describe the perspective of the: (1) Patient and Public;[14] (2) Physician;[15] (3) Emergency Medical Services (EMS) and the hospital emergency department (ED);[16] (4) Hospital;[17,18] and (5) Payers.[19] Additionally, the conference proceedings recommended STEMI system evaluation measures [20] and noted gaps, barriers, and the implications of these problems.[21]

These documents are being used to guide the implementation of a STEMI system of care in California.

National Association of Emergency Medical Service Physicians

In 2007, the National Association of Emergency Medical Service Physicians (NAEMSP) recommended: (1) training for EMS providers to facilitate identification of STEMI patients; (2) pre-hospital ECGs to facilitate STEMI diagnoses; (3) systems of care with preferential transport of selected patients to PCI centers and, when appropriate, the pre-hospital administration of fibrinolytic therapies; (4) pre-hospital EMS communication with receiving facilities; and (5) quality assurance programs for STEMI care.[22]

American College of Cardiology

In 2005, the American College of Cardiology (ACC) reported that less than half of U.S. hospitals had median door-to-balloon (D2B) times (the time between hospital arrival and angioplasty balloon inflation) within the recommended 90 minutes or less for STEMI patients. To reduce D2B times, the ACC launched an initiative, D2B: An Alliance for Quality™. The D2B Alliance's goal is to increase hospital use of six key evidence-based strategies that have been proven to reduce D2B times. These six core strategies are: (1) ED physician activates the cath lab; (2) One call activates the cath lab; (3) Cath lab team ready in 20 to 30 minutes; (4) Prompt data feedback; (5) Senior management commitment; (6) Team-based approach. By 2007, more than 900 hospitals across the nation had joined the D2B collaborative, and work to improve D2B times was begun. A baseline study in 2007 showed that although many hospitals used some of these key strategies, few had adopted them all, leaving much room for improvement.[23]

ACTION

National

Across the nation, systems of care are being developed to provide optimal treatment for STEMI patients.[24,25,26,27] Direct transport of STEMI patients to hospitals that meet established criteria for excellence has gained traction in several states, including Minnesota, North Carolina, and Massachusetts,[13] as well as in some parts of California.

California

State statutes and regulations empower the California Emergency Medical Services Authority (EMS Authority) to provide oversight to local Emergency Medical Services Agencies (LEMSAs) based on regulations and guidelines, upon review and approval of the Commission on EMS.

Thirty-one LEMSAs blanket the state. Some have single-county jurisdictions, and others have jurisdiction over multiple counties. Each LEMSA plans, implements, and evaluates the EMS system pursuant to state statutes, regulations, and guidelines, and is responsible for developing the STEMI Subsystem Plan as part of the state-required EMS Plan. The LEMSA oversees and coordinates the local process to implement the STEMI Subsystem Plan, which involves numerous components, such as certification, accreditation, and education of pre-hospital personnel; development of patient care and destination policies; data collection; designation of specialty care centers, including STEMI care centers; site surveys; and administration of systemwide quality improvement. Some LEMSAs also oversee Emergency Medical Dispatch programs responsible for dispatching appropriate medical resources.

In 2009, LEMSAs with established or developing STEMI systems included Alameda, Coastal Valleys, Contra Costa, Los Angeles, Marin, Merced, Monterey, Mountain Valley, Orange, Riverside, Sacramento, San Diego, San Francisco, Santa Clara, Santa Cruz, Solano, and Ventura. Some of these systems of care have served as models for statewide promulgation of the concept.

Although the progress made by the LEMSAs toward improved STEMI care in California has been encouraging, public health professionals in both the public and private sectors realized that unless the development of STEMI systems of care was guided at the outset on a statewide basis (in much the same way that the trauma system was developed), there would be service gaps that would become progressively more difficult to overcome. A fragmented system of care is a significant obstacle to reducing morbidity and mortality from heart disease.

This sort of planning was advocated by the California Heart Disease and Stroke Prevention and Treatment Task Force (Task Force), an advisory group that was convened in 2006 under a law (Assembly Bill 1220) passed in 2003. The Task Force was charged with writing *California's Master Plan for Heart Disease and Stroke Prevention and Treatment* (Master Plan).[28] The Master Plan was adopted in 2007.

The STEMI system of care proposed by the Master Plan encourages identification of eligible patients in the field and direct transport to hospitals that provide the most appropriate acute care. It envisions the creation of STEMI-Receiving Centers (SRCs), hospitals that provide optimal STEMI care. The Master Plan stresses the importance of building a system that is fully inclusive, thereby avoiding service gaps. This concept is consistent with the position statements of the AHA/ASA and other expert groups, as well as with the vision being realized by other states across the nation.

The Task Force recognized the many technical and policy issues inherent in the development of a STEMI system and recommended the establishment of a STEMI Systems Work Group.

In 2007, the STEMI Work Group was co-convened by the CHDSP and the AHA/ASA to implement the STEMI recommendations of *California's Master Plan for Heart Disease and Stroke Prevention and Treatment*. This is a

multidisciplinary group that includes experts in emergency medical services, emergency medicine, cardiology, specialty nursing (cardiology and emergency), hospital administration, and rural health care. The Work Group includes representation from the major public and private organizations that promote quality STEMI care, including: the ACC, California Chapter, which joined as a co-sponsor of the project; the California Hospital Association; California Chapter, American College of Emergency Physicians (CAL/ACEP); California Emergency Medical Services Authority (EMS Authority); Emergency Medical Services Administrators Association of California (EMSAAC); Emergency Medical Services Medical Directors Association of California (EMDAC); and city and county departments of public health. The Work Group met in person and electronically throughout their work period.

The outcome from the deliberations of the Work Group is this document, *The Recommendations for the Early Management of Adults with ST-Elevation Myocardial Infarction: A Statewide Plan for California* (Recommendations). The Recommendations were informed by the experiences of the LEMSAs that have implemented STEMI systems. Every effort was made to use the systems that have been established as a foundation for the future. The intent of this document is to describe a system of care that promotes the safe use of effective therapies for STEMI, assuring that every Californian will receive the highest level of STEMI care. These Recommendations are consistent with position statements around optimal patient care offered by STEMI care advocates, including 2004 ACC/AHA STEMI guidelines,[5] the 2007 and 2009 ACC/AHA focused STEMI guideline updates[29,30] and the 2008 European Society of Cardiology STEMI guidelines.[31]

SUMMARY OF RECOMMENDATIONS

1. The EMS Authority, with LEMSA partners, should establish recommendations, guidelines, and regulations to develop a system of care for STEMI so that optimal STEMI care will be accessible throughout California. This will assure a uniformly high standard of STEMI care across the State.
2. LEMSAs should be adequately funded and staffed to establish and monitor STEMI systems of care.
3. The Recommendations (this document), created by the STEMI Work Group, California's recognized expert panel on STEMI care, will serve as an important resource document for LEMSAs when developing their STEMI systems of care. Although these Recommendations establish the best practices for excellence in STEMI care, each LEMSA's approach to implementing these Recommendations may vary. The Recommendations also allow flexibility at the local level, based on local needs and resources.
4. Key elements of the STEMI Systems of Care are:
   a. EMS responders, for field triage and transport
   b. STEMI-Receiving Centers (SRCs)—hospitals which are able to deliver timely PCI through experienced clinicians and also meet other quality measures
   c. STEMI-Referral Facilities (SRFs)—hospitals that can deliver fibrinolysis, but not PCI, and meet other quality standards including transfer agreements with SRCs and transfer protocols
   d. Non-designated hospitals (NDHs)— hospitals that, by definition, lack a transfer agreement and protocol for partnering with an SRC. NDHs must be integrated into the system because they may receive transported patients if they are the only hospital available, or STEMI patients may self-transport to these facilities.
   e. LEMSAs, which are uniquely poised to provide system evaluation and quality improvement.
   f. Consideration of new and developing technologies such as telemedicine.
5. In developing these STEMI Systems of Care, LEMSAs should develop policies and procedures that facilitate the most rapid reperfusion of the STEMI patient. The goal

should be to reperfuse patients 100 percent of the time within time intervals established by the most current clinical guidelines. Currently, those time intervals are: fibrinolysis within 30 minutes of "first medical contact" (defined as arrival at the ED or contact with paramedics), if reperfusion is to be accomplished by fibrinolysis; or deployment of the balloon device less than 90 minutes from first medical contact (arrival at the ED or contact with paramedics), if reperfusion is to be accomplished by PCI.[5] Because PCI has been found to be superior to fibrinolysis when performed in a timely fashion by an experienced clinician,[9] currently the intent of these policies and procedures should be to deliver STEMI patients preferentially to SRCs. To facilitate the most rapid reperfusion of STEMI patients, LEMSAs should develop policies and procedures that:

a. Encourage accurate field identification of STEMI patients through the use of pre-hospital 12-lead electrocardiograms (PH 12-lead-ECGs). Paramedics should receive orientation to the local STEMI system of care and training on use of 12-lead ECG equipment as part of local accreditation.
b. Encourage preferential transport of STEMI patients to the most appropriate care facility.
c. Monitor and evaluate pre-hospital on-scene times.
d. Encourage early notification from the field that a STEMI patient is en route to the receiving hospital. This notification may include paramedics' direct activation of the catheterization team at the SRC. Criteria for EMS activation of a cath lab should be established cooperatively by LEMSAs and SRCs. Although reducing delay to reperfusion is imperative, there is also a need to minimize false activation of the cath lab. LEMSAs and hospitals should work together to balance these considerations.
d. Set criteria for the designation of SRCs that follow state recommendations, guidelines, regulations, and statutes; and use guidelines advanced by standands-setting organizations such as the ACC/AHA.

e. Identify a process for the renewal of SRC designation.
f. Set criteria for SRF designation.
g. Encourage NDHs to achieve SRF status, as evidenced by transfer agreements with SRCs. Safeguards should be established to ensure that hospitals that do not achieve either SRC or SRF status deliver STEMI care that meets the highest and most feasible standards. Non-designated hospitals should participate in the LEMSA's data collection/quality improvement program.
h. Assure nondiversion of STEMI patients by SRCs, except when the cath lab is already occupied by a STEMI patient.
i. Encourage rapid interhospital transfer of STEMI patients, including:
   - Patients who self-transport or are transported to an SRF or NDH and require transfer to an SRC
   - Patients transported to an SRF or NDH because an SRC is not within a reasonable transport time frame
   - Patients who are delivered to an SRF by EMS (per LEMSA protocol) for fibrinolysis and require transfer to an SRC for follow-up PCI
   - Patients who fail fibrinolysis at an SRF and require transfer to an SRC for rescue PCI.
j. Encourage synchronization of clocks by all personnel involved in STEMI emergency care from receipt of the 911 call through reperfusion. This will allow accurate determination of time intervals that have clinical significance, thus facilitating quality improvement.

6. In rural/remote areas, consideration should be given to using outside SRC expertise via telemedicine and other new technologies.
7. To assure optimal quality care, LEMSAs should establish a multidisciplinary STEMI Continuous Quality Improvement (CQI) Committee that is disclosure-protected according to California Evidence Code section 1157.7. This Committee should include representation from LEMSA leadership, EMS providers, cardiologists, and hospitals (administration, cath lab leadership, and other staff). All

hospitals in the LEMSA jurisdiction (SRCs, SRFs, and NDHs) should be represented to assure that all hospitals are integrated into the system. This is necessary to avoid service gaps and assure that all members of the public will have access to the best STEMI care. The duties of the STEMI CQI Committee should be to:

a. Provide input into the LEMSA's STEMI Subsystem Plan and associated policies such as STEMI patient triage and treatment, SRC and SRF initial and renewal designation standards, patient destination, etc.
b. Provide input into the identification of data elements to be collected and the evaluation process used to review and improve the system.
c. Review data submitted by SRCs and SRFs per LEMSA requirements in an effort to help the LEMSA identify opportunities for system enhancement.
d. Provide disclosure-protected review of selected STEMI cases such as those involving outstanding care, educational value, preventable death or disability, non-compliance with system standards, patients who fell outside of system criteria, etc.
e. Develop quality improvement indicators to measure the quality improvement process.
f. Develop short- and long-term goals and objectives.

8. In the future, LEMSAs should consider regional cooperation to strengthen the systems approach to highest quality STEMI care.
9. The AHA/ASA, ACC, CDPH, the EMS Authority, SRCs, SRFs, county health departments, and others should conduct or promote public education efforts to help reduce the self-transport of STEMI and other cardiac patients.

CHALLENGES

California's size and diversity (e.g., population distribution and resources) have an important impact on STEMI care, as does the management of EMS systems at the local level. There are significant differences in 911 call processing, dispatch capabilities, EMS response, and hospital services across the State.

- Public education and awareness are not sufficient to create the political will needed for the development of STEMI systems of care.
- Some rural areas have 911 dispatchers who are not specifically trained in emergency medical dispatching. These individuals may be volunteers, and there can be considerable turnover. This makes sustaining a trained workforce difficult.
- EMS responders in rural areas may face distance and weather challenges, which can contribute to delay in patient transport. In addition, a decision to send EMS responders out of the area for a period of time (for example, to transport a STEMI patient for PCI at a distant hospital) must be carefully considered. Such a decision may deprive the community of EMS services until responders return.
- In some areas of the state, 911 calls made from wireless phones are routed to a regional Public Safety Answering Point (PSAP) instead of a local PSAP. Regional PSAPs may not be as well equipped in terms of equipment and personnel as the local PSAPs; as a result, calls may not be answered. Also, this process often requires additional call transfers. The result may be a delay in response.
- Some hospitals in rural areas lack the necessary personnel, equipment, and protocols required to treat STEMI patients rapidly and in accordance with recommended clinical guidelines. At a minimum, a facility must have a 24-hour emergency department, laboratory, and immediate access to appropriate pharmaceuticals to deliver fibrinolysis emergently. Consultation with a cardiologist may be needed, but

specialists are often scarce in rural areas.

- Consideration should be given to using outside SRC expertise via telemedicine and other new technologies. Rural outreach training to help optimize patient care and transfers should also be considered.
- Nationwide, more than half of the patients who have a heart attack are driven to the nearest hospital by family members or friends.[32] This self-transport means the patient misses the opportunity to be triaged and transported by EMS responders to a center that can provide the most appropriate care, as determined by LEMSA policy. Self-transport also means that patients miss the opportunity to have conditions that can accompany heart attack treated en route to the hospital. The AHA, ACC, CDPH, the EMS Authority, SRCs, SRFs, county health departments, and others should conduct or promote public education efforts to help reduce the self-transport of STEMI and other cardiac patients.
- Patients are best served through the early identification of STEMI. This allows preferential transport to a STEMI-Receiving Center for primary PCI. Pre-hospital identification of STEMI requires the use of a 12-lead ECG. Currently, only about half of LEMSAs have some ambulances with 12-lead ECG equipment on board and policies to determine destination.[33] Acquisition of this equipment and proper training of EMS responders in its use may prove too expensive for many LEMSAs.
- The costs associated with implementing a STEMI system of care (e.g., data monitoring, establishment of a STEMI Oversight Committee) may require that LEMSAs seek funding from external sources.

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Pre-Hospital STEMI Care

Because heart disease is the leading cause of death and long-term disability in California.

Goal:

Development of a pre-hospital system that provides rapid identification, focused field treatment, and efficient transport of STEMI patients to the most appropriate care center.

LEMSAs plan, implement, and evaluate EMS services for their jurisdiction. Specific responsibilities include: (1) setting destination policies for ambulances based on the LEMSA's assessment of hospital specialty care services and (2) enabling rapid transport of patients to tertiary care. These particular responsibilities are critically important in the delivery of care to patients who require time-sensitive therapies, and they explain LEMSAs' key roles in developing California's trauma system in the 1990s. Now LEMSAs are in a position to establish systems of care for STEMI, another time-sensitive condition.

The California Emergency Medical Services Authority (EMS Authority) should establish recommendations, guidelines, and/or regulations, in cooperation with LEMSA partners, to develop STEMI systems of care. This will assure uniformly high standards of STEMI care across the State. The Recommendations developed by the STEMI Work Group, California's recognized expert panel on STEMI care, is an important resource document for LEMSAs when developing their systems of care for STEMI. Although the recommendations establish best practices for excellence in STEMI care, LEMSAs' approaches to implementing these Recommendations may vary. The Recommendations also allow flexibility at the local level, based on local needs and resources.

STEMI systems in urban/suburban areas may look vastly different from those in rural/remote areas. Urban/suburban areas are more likely to be served by ambulances that have 12-lead ECG capability, thus affording PH 12-lead-ECG and triage to PCI-capable hospitals. These areas are likely to have many hospitals that are capable of performing primary PCI. Rural/remote areas, on the other hand, may not have easy access to primary PCI; PCI-capable hospitals may be hours away. This not only makes timely PCI difficult, but also takes resources (the ambulance and paramedics) out of service to the community for a prolonged period. Also, weather and mountain roads may complicate and extend transport times. In designing STEMI systems of care, LEMSAs must consider all these factors.

EMERGENCY MEDICAL DISPATCH

Optimal STEMI care begins with receipt of the 911 call. Call centers in most urban areas include Emergency Medical Dispatchers (EMDs), who are specifically trained and/or certified to field calls of a medical nature. EMDs typically operate in a "prioritized dispatch system," which enables the assignment of appropriate resources and a level of urgency for each medical call. EMDs use a caller interrogation/EMS response tool (there are several proprietary products available in both card and computer formats) to help identify the patient's medical condition based on the information provided by the caller. For any given medical condition, the caller interrogation/EMS response tool provides information to the EMDs on the general level of EMS response that is needed, as well as the advice that should be given to the patient, family, and/or bystanders. The caller interrogation/EMS response tool may be customized by the LEMSAs to reflect the response needs and capabilities of a local area. Vendors of these caller interrogation/EMS response tools may require that EMDs receive periodic training in their use to become "certified."

In contrast, 911 calls made to rural call centers are sometimes received by dispatchers whose role is limited to deciding whether a call requires a law enforcement, fire, or medical response. If a medical response is needed, it is sent at the highest priority level.

As LEMSAs develop STEMI systems of care, they should ensure that their standardized written protocols for dispatch recognize the emergent nature of heart attack (acute myocardial infarction or AMI), a medical classification that includes STEMI. At all 911 call centers, dispatch for AMI should be at the highest appropriate priority level. In environments that are suitable for prioritized medical dispatch, the LEMSA should require the use of a caller interrogation/EMS response tool that meets current standard of care for EMD practice. EMDs may be required to be certified by the vendor of the tool or otherwise prove competence in its use. LEMSAs may

also choose to "accredit" EMDs as a means of verifying their competence.

The STEMI system should include Continuous Quality Improvement (CQI) measures to ensure that dispatchers consistently and correctly follow written protocols.

Procedures

In a STEMI system of care, the dispatch response to cardiac chest pain or associated symptoms should include appropriate processes that ensure rapid access to treatment.

1. Use of a formal caller interrogation/EMS response tool
   a. LEMSAs should identify and authorize the uniform use of a caller interrogation/EMS response tool for prioritized emergency medical dispatch. This tool should include a specific algorithm for the identification of suspected AMI.
   b. LEMSAs should require that EMDs prove competence in the use of the tool (i.e., vendor certification or LEMSA accreditation).
   c. LEMSAs may customize the tool to reflect the resources available in their region.

2. Training of dispatchers
   a. In areas that use prioritized dispatch, LEMSAs should require that EMDs receive adequate education on the use of the caller interrogation/EMS response tool. Education may be provided by the vendor, the EMD provider agency, the LEMSA, or the LEMSA's designee.
   b. LEMSAs should consider adopting an accreditation process that verifies the EMDs' competence in use of the tool that incorporates the identification of suspected AMI.

3. Dispatch
   a. In areas that use prioritized dispatch, dispatchers should provide instructions for patients, family, and/or

bystanders as they wait for EMS, as determined by the LEMSA. These instructions should be consistent with latest guidelines and, at a minimum, should include:

   i. Recommendation that basic life support action, such as cardiopulmonary resuscitation (CPR), be taken.
   ii. With the approval of local medical control, recommendation that aspirin be administered.

b. EMS responders should be dispatched by protocols requiring the highest appropriate level of response for suspected AMI, with the closest most appropriate resources available.
c. The time-from-call to dispatch of EMS response should meet or exceed the goal established by the LEMSA.
d. LEMSAs are encouraged to provide language resources (i.e., interpreters) in areas where a large segment of the population has limited English-speaking skills.

EMS RESPONDERS

In California, EMS emergency vehicles that are staffed by emergency medical technicians (EMTs), paramedics, and/or nurses are fully equipped, at a minimum, for Basic Life Support, including ventilation and oxygenation capabilities. Additionally, LEMSA-authorized Advanced Life Support providers and aeromedical providers using nurses may be equipped with 12-lead ECG equipment.

The key responsibilities for pre-hospital patient care providers when caring for chest pain patients are:

- Early recognition of signs and symptoms of heart attack.
- PH 12-lead-ECG assessment (if EMS vehicle is equipped). There are three interpretation strategies: direct paramedic interpretation, automated computer algorithm, and wireless transmission followed by physician interpretation—or a combination of all three.[34]
- Completion of a fibrinolytic checklist (see Appendix A), as indicated by LEMSA protocol, for patients with PH 12-lead-ECG evidence of a STEMI; this checklist helps identify patients who are ineligible for fibrinolytics and need transport to a facility that can perform PCI.

- PH 12-lead-ECG and checklist findings communicated (by radio or electronically) to the most appropriate care facility.
- Suspicious or complex findings are communicated to on-line medical control per LEMSA protocol.
- Pre-hospital treatment according to scope of practice (e.g., oxygen, aspirin, nitroglycerine, and morphine).
- Rapid transport to the most appropriate care facility along with early notification to the receiving facility.

For appropriate and time-sensitive triage, first responders should be trained to recognize the signs and symptoms of AMI. To promote competency in this area, all EMS responders should be encouraged to participate in periodic pre-hospital AMI recognition and treatment education. Paramedics should be trained to use ECG equipment. Training should include proper placement of electrodes on the patient, parameters of acceptability of an ECG tracing, and communication of results. Results may be conveyed by automated computer algorithm, by wireless transmission with physician interpretation, or by direct interpretation by the paramedic. Paramedics should be adept at using the communication strategy that prevails in their area. To assure competency, paramedics, and other EMS responders as permitted, should be required to participate in periodic education on: (1) signs and symptoms of heart attack; (2) use of ECG equipment; and (3) the use of a fibrinolytic checklist, as indicated by LEMSA protocols.

Procedures

The EMS response to STEMI should include processes that ensure identification of STEMI patients and rapid access to treatment. In a STEMI system established by a LEMSA, the pre-hospital system of care should include:

1. Training of all EMS responders
   EMS responders, as permitted by their scopes of practice, should receive training in the use of PH 12-lead-ECG to identify STEMI; the use of a fibrinolytic checklist, if indicated by LEMSA policy; and EMS assessments and

treatment for STEMI. The goal should be to train 100 percent of practice-eligible EMS responders (currently paramedics) to use PH 12-lead-ECG to identify STEMI and provide appropriate field management.

The EMS Authority and/or LEMSAs should ensure that paramedics are appropriately trained through one or more of the following options:

- Paramedics receive orientation to the local STEMI system of care as part of accreditation or by revision of the State Paramedic Regulation.
- Providers of ambulance services offer pre-hospital STEMI training as part of their contractual service agreements.
- Hospitals that have been designated by LEMSAs as SRCs (see definition in "Hospital" section of this document) provide pre-hospital STEMI training for EMS responders.
- STEMI training and triage outcomes are identified as part of a CQI process.

TRANSPORT

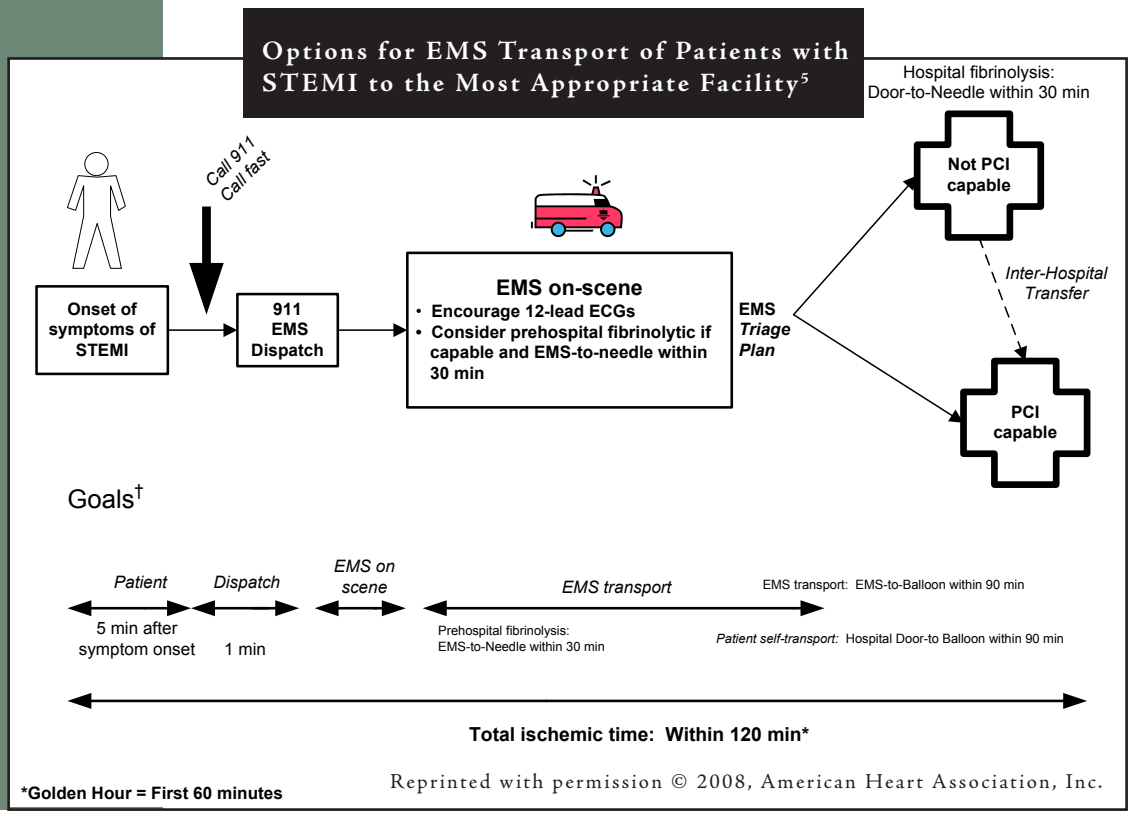
LEMSA-designated STEMI systems of care should have established policies and protocols for assessment, triage, and rapid transport of STEMI patients to the most appropriate care center. Transport policies should: (1) take into account the suspected STEMI patient's eligibility for time-sensitive treatment, (2) establish protocols for rapid on-scene evaluation and expedited transportation, (3) establish protocols for rapid transport of PH 12-lead-ECG-confirmed STEMI patients to the most appropriate care center, (4) emphasize direct transport of patients to minimize the need for interfacility transfer, (5) emphasize the importance of notifying hospitals, either directly through the EMS or the base hospital, that a suspected STEMI patient is en route, thus allowing advanced preparation for receipt of the patient, and (6) in cooperation with SRCs, establish protocols that activate the cath lab team in advance of the patient's arrival. Currently, many SRCs prefer that paramedics obtain a PH 12-lead-ECG and transmit results

wirelessly (if possible) to a physician who interprets the results and then activates the cath lab, if necessary. However, other strategies are possible, including direct activation of the cath lab by paramedics in the field when they have identified a STEMI patient by either direct interpretation of the ECG or by computer algorithm; if these patients are found not to be having a STEMI once they are evaluated in the ED, the ED can cancel the cath lab activation. When appropriate and allowed by local protocol, care of a PH 12-lead-ECG-identified STEMI patient may also include bypass of the ED and direct transport to the cath lab.

Procedures

1. LEMSA destination policies

   As LEMSAs develop STEMI systems of care, they should establish patient destination policies that stipulate that suspected STEMI patients be transported directly to the hospital that is most appropriate for their condition. These policies should be consistent with the following flowchart as recommended by AHA/ASA.



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Specifically:

a. PH 12-lead-ECG-confirmed STEMI patients should be transported directly to an SRC if anticipated transport time allows PCI within the recommended therapeutic window. Under current recommendations, PCI should be delivered within 90 minutes of first medical contact. Shorter time to treatment is associated with a better outcome, so the emphasis should be on rapid transport.

   To help field personnel decide whether to transport a STEMI patient to an SRC for PCI or to a closer hospital for fibrinolysis, LEMSAs should establish "maximum transport times." In general, STEMI systems that are operating now in urban areas are delivering PH 12-lead-ECG-confirmed patients directly to SRCs if transport times are expected to be 30 minutes or less. In rural/remote areas, maximum transport times may need extension due to distance and weather considerations; however, transport times cannot be extended too much or PCI within the recommended treatment window will become unlikely. Furthermore, communities may be left without paramedics and emergency vehicles while the STEMI patient is being transported to a distant SRC. These considerations have led some STEMI systems currently operating in rural/remote areas to establish 45 minutes as the maximum time allowed for transporting a STEMI patient to an SRC.

b. PH 12-lead-ECG-confirmed STEMI patients should be transported to the nearest hospital for fibrinolysis if anticipated transport time to the nearest SRC exceeds maximum transport times established by the LEMSA.
c. Suspected STEMI patients with contraindications to fibrinolytic therapy, as determined by pre-hospital fibrinolytic checklist, should be transported directly to an SRC, if such a checklist strategy is used in the LEMSA protocol.
d. LEMSAs should establish policies regarding hospitals'

requests to divert (reroute) STEMI patients to another facility. Diversion requests are typically made when a destination hospital is temporarily unable to provide timely care in the ED resulting from patient crowding, overcrowding, or a surge. The STEMI System Work group recommends that diversion of STEMI patients not be permitted unless the cath lab at the destination hospital is already occupied by a patient undergoing PCI or another procedure.

e. Suspected heart attack patients who cannot be assessed in the field for STEMI because of absence of PH 12-lead-ECG, or chest pain patients with inconclusive findings, should be transported directly to the closest EMS receiving hospital.

f. EMS responders should notify receiving EDs in advance of an incoming suspected heart attack patient and should communicate the PH 12-lead-ECG results or interpretation (if available).

2. Mode of transportation

In STEMI systems of care, STEMI patients should undergo safe, rapid transport to the closest facility that provides the appropriate level of STEMI care. In most circumstances, this will involve ground transport; however, if indicated, air transport may be considered to shorten time to treatment in accordance with local EMS policy.

3. Rapid Transport

Given the emergent nature of STEMI, LEMSAs should promote rapid, but safe and efficient, response and transport appropriate to the medical needs of the patient and in compliance with national EMD standards where these are utilized.

a. LEMSAs should encourage expeditious on-scene times.

b. EMS should transport patients at the most appropriate response level.

c. LEMSAs should monitor response times through the CQI process.

Improvements in STEMI outcomes require an ongoing commitment from every member of the health care team. These efforts are intended to inform the process and to improve disease outcomes. Evaluation of pre-hospital STEMI care may occur at many levels and with varying degrees of complexity; however, ensuring that appropriate measurement tools are implemented will facilitate this process. LEMSAs should establish benchmarks that are consistent with current guidelines for each of these measures.[13] Development of measurement tools and benchmarks for STEMI patients is best done at state or national levels to ensure uniformity, rather than at 31 different LEMSAs.

Procedures

1. Engage in CQI

   The success of the pre-hospital component of the STEMI system of care will depend on objective data to assess and improve the process. The overall goal of a STEMI system of care is to continuously improve quality of care, thereby improving health outcomes.

   a. Structure: Evaluation of the pre-hospital component of the STEMI system should include assessment of these structural components:
      - Dispatch protocols requiring the most appropriate priority level of response for cardiac chest pain or associated symptoms.
      - Adequately trained and equipped staff to provide early field identification and appropriate medical management and transport of STEMI patients.
      - Ongoing didactic and clinical education of EMS responders.
      - Standardized STEMI checklist/algorithm of evaluation and treatment (e.g., AHA/ASA Acute Coronary Syndromes Algorithm or similar tool: see Appendix B) as part of local EMS protocols.
      - Fibrinolytic checklist for STEMI, if operationally indicated.

- Destination protocols or policies that optimize use of medical resources.
- Local CQI Committee (including cardiologists, ED physicians, hospital representatives, and EMS) convened by the LEMSA. The LEMSA should establish a quality assurance process/policy pursuant to California Evidence Code 1157.7 that extends disclosure protection for the confidential proceeding of the Committee.
- CQI assessment of EMS educational needs and opportunities for STEMI system enhancement.

b. Process:

In a STEMI system established by a LEMSA, data elements for STEMI should be collected and analyzed. Appendix C lists recommended data elements. These data elements should be used to evaluate the following EMS process measures or benchmarks.

- Time from symptom onset to 911 call.
- Time from receipt of 911 call to dispatch of EMS.
- Time from dispatch of EMS to EMS arrival.
- Time from EMS arrival to patient contact.
- On-scene time
- Patient contact time to depart scene time
- Interfacility transport time, if applicable.
- Transport time from scene to ED arrival.
- Time from patient contact to ED arrival.
- Time from PH 12-lead-ECG to ED arrival.
- Total EMS contact time (i.e., time from receipt of 911 call to hospital arrival).
- Use of documented fibrinolytic checklist.
- PH 12-lead-ECG assessment completed.
- STEMI patients routed to designated STEMI-receiving hospital .

To assess the accuracy of field triage, the following measures should be collected by EMS, in cooperation with the receiving hospital:

- Over/Under Triage–Patients identified by EMS as

potential STEMI patients who did not/did receive a hospital diagnosis of STEMI.

- False activation of the cath lab.
- Documentation of pre-arrival notification by the receiving facility.

c. Outcomes

- Dispatch and EMS responder primary impression should be compared with the final hospital diagnosis.

2. Report Quality Improvement Progress

The LEMSA should establish a disclosure-protected STEMI CQI Committee as an advisory group that provides input on standards, policies, data elements, reporting requirements, and other parameters relating to STEMI system quality. (See "System Implementation" section for specifics.)

Hospital STEMI Care

Because heart disease is the leading cause of death and long-term disability in California.

Goal:

Development of a regional hospital system that provides optimum STEMI treatment for every STEMI patient.

Percutaneous coronary intervention (PCI) must be performed in a cardiac catheterization laboratory (cath lab). Of the 497 hospitals that submitted a utilization report to the California Office of Statewide Health Planning and Development in 2007, 174 hospitals reported that they have "one or more rooms used as a cath lab." Of these hospitals, 135 performed at least one catheterization procedure in 2007.[35]

Theoretically, one possible solution to increasing the availability of PCI would be to enhance the capability of the cath labs to make them PCI-capable. However, this strategy would only expand the availability of PCI very modestly, because hospitals with cath labs tend to be clustered, leaving large geographical gaps in service. One theoretical alternative, establishing a PCI-capable cath lab at all hospitals, would be prohibitively expensive and would dilute the number of cases for each hospital, thereby risking every cath team's proficiency. The remaining and most viable option is to establish a STEMI system of care that refers STEMI patients quickly and reliably to PCI-capable hospitals.

Hospitals in a LEMSA's county or region can be classified as follows:

- ***STEMI-Receiving Centers (SRCs).***[36] These hospitals are capable of delivering the most rapid and effective available reperfusion therapy to STEMI patients. Currently, that therapy is PCI. Designated SRCs should meet established criteria (see below) including the ability to provide primary PCI (24 hours a day, 7 days a week, 365 days a year). SRCs should be the preferred destination for: (1) PH 12-lead-ECG-confirmed STEMI patients transported by EMS and (2) STEMI patients for whom fibrinolysis is contraindicated, as determined by local protocols. SRCs must expect to receive patients transferred by STEMI-Referral Facilities and should have appropriate transfer agreements and transfer protocols (see sample, Appendix D) in place.

- ***STEMI-Referral Facilities (SRFs).*** These hospitals have the ability to perform fibrinolysis; however, they lack PCI capability. SRFs should have a formal written transfer protocol (See sample, Appendix E) and a transfer agreement with a temporally close SRC. The transfer agreement should stipulate prompt transfer (urgency equivalent to 911).

- ***Non-designated hospitals.*** These hospitals do not meet the criteria for being a designated SRC or SRF; therefore, EMS should regard such facilities as the least appropriate care facilities for acute STEMI patients. However, despite efforts to educate the public about the importance of calling 911 in the event of chest pain, some patients may still self-transport to these facilities. Additionally, patients may be more than 30 minutes away by ambulance from an SRC or an SRF, so non-designated hospitals may receive patients by ambulance according to local EMS policies. LEMSAs should encourage these facilities to have a policy that requires appropriate fibrinolytic therapy and written agreements with the closest SRCs for immediate transfer. (These steps would qualify non-designated hospitals for SRF status). These facilities should also consider using telemedicine and other tools to provide real-time consultation with an SRC cardiologist. SRCs should provide rural outreach training for non-designated hospitals to ensure optimal care of STEMI patients.

LEMSAs should aspire to having l00 percent of their hospitals participate as either SRCs or SRFs.

Advocates for optimal STEMI care have given thoughtful consideration to identifying criteria for designation of SRCs and SRFs. The AHA's Mission: Lifeline™, a national initiative to improve STEMI outcomes through the establishment of STEMI systems of care, has proposed recommendations.[29] The STEMI Work Group considered and adapted those recommendations as follows:

SRC CRITERIA

Criteria for Designation as a STEMI-Receiving Center

1. Protocols for triage, diagnosis, and cath lab activation should be established within the SRC. A single activation phone call should alert the STEMI team. A single phone call should activate the cath lab. Consideration should be given to activation of the cath lab from the field. [Example of current practice: In some LEMSAs, if the field ECG reads "acute STEMI," paramedics activate the cath lab and the cardiologist from the field. When the patient arrives at the SRC, the ED physician will cancel the alert if examination of the patient indicates that he/she is not having a STEMI.] The hospital should have a process for monitoring false or inappropriate activation of the cath lab.
2. The SRC should be available 24 hours a day/7 days a week to perform primary PCI.
3. The cath lab staff, including interventional cardiologist, should be available within 30 minutes of activation call. [Examples of current practice: In some hospitals a diagnostician starts the case in the cath lab, and then the interventionalist finishes the procedure. In other hospitals, the interventionalist handles the case from start to finish. Individual hospitals should assess which model leads to quicker reperfusion of the patient. This assessment should also be a part of the LEMSA's CQI program, allowing the comparison of practices across SRCs.]
4. There should be universal acceptance of STEMI patients from field or transfer. Specifically, unwarranted diversion, pre-screening of patients, insurance checks, and refusal of transferred patients should not be acceptable practices. A plan for triage and treatment for simultaneous presentation of STEMI patients should be in place.
5. Volume of procedures is often used as a surrogate for competence. The ACC/AHA recommends that a hospital perform a minimum of 36 primary (emergency) PCI procedures and 200 total (emergency plus elective) PCI procedures annually to qualify as an SRC. The ACC/AHA further recommends that interventional cardiologists at

these centers perform at least 11 primary (i.e.,emergency) PCI procedures per year and 75 total (emergency plus elective) PCI procedures per year. Although these numbers are ideal, it is clear that some hospitals will not be able to reach these numbers due to the size of the population they serve and other factors. Therefore, the LEMSA may opt to designate hospitals with lower procedure volumes, as long as it has a quality assurance mechanism in place to measure mortality and other outcomes of PCI. The overriding concern is to ensure timely, safe, and effective PCI.

6. The SRC should participate in standardized data collection. [Example of current practice: Some SRCs are using the National Cardiovascular Data Registry - Acute Coronary Treatment and Intervention Outcomes Network (NCDR ACTION) Registry data collection tool. See Appendix F.]
7. The SRC should synchronize its clocks internally, as well as with EMS, so that the reported time intervals are accurate and can serve as a legitimate basis for quality improvement. Coordinated Universal Time (UTC) can be obtained from a number of Internet sites, GPS, and the United States National Institute of Standards and Technology's shortwave radio station WWV. Many devices are available to link UTC to timepieces.
8. A program should be in place to track and improve treatment (acutely and at discharge) with ACC/AHA guideline-based Class I therapies.
9. There should be a recognized SRC liaison/system coordinator and a recognized physician champion.
10. There should be regular multidisciplinary team meetings to evaluate outcomes and CQI data. Operational issues should be reviewed, problems identified, and solutions implemented.
11. The SRC should engage in community education about the signs and symptoms of heart attack and the need to call 911.

SRF CRITERIA

Criteria for Designation as a STEMI-Referral Facility

1. Appropriate written protocols and standing orders should be in place for the identification of STEMI. At a minimum, these protocols should be present in the Intensive Care Unit/Coronary Care Unit and Emergency Department (ED).
2. Each ED should maintain a standardized reperfusion STEMI care pathway that designates primary PCI as the preferred reperfusion strategy if transfer of patients to an SRC and reperfusion can be achieved within times consistent with ACC/AHA guidelines.
3. Each ED should maintain a standardized reperfusion STEMI care pathway that designates fibrinolysis in the ED (for eligible patients) when the system cannot achieve times consistent with ACC/AHA guidelines for primary PCI.
4. If reperfusion strategy is for primary PCI transfer, a streamlined, standardized protocol for safe, rapid transfer and transport to an SRC should be operational. The protocol should include: (1) pre-arranged agreements with SRCs for transfer of patients, and (2) pre-arranged agreements with EMS providers for rapid transport of STEMI patients. Inter-hospital transport should be made with the same urgency as a 911 call. Hospitals and EMS should strive to limit the time interval from arrival at the SRF door to ambulance departure to less than 30 minutes. If the patient arrives at the transferring hospital via EMS, consideration may be given to protocols that require the suspected STEMI patient to remain on the same gurney and with the same attendant EMS staff until the determination to transfer or not transfer is made based on operational parameters of the EMS system.
5. If reperfusion strategy is for primary PCI transfer, all patients should be transported to the most appropriate SRC where the expected first D2B (first device used) time should be less than 90 minutes (considering ground versus air transport, weather, traffic).

6. The SRF should have an ongoing CQI process, including data measurement and feedback for the STEMI population and collect and submit standardized data. (Example of current practice: Some SRFs are using the ACTION Registry-GWTG Short Form. [See Appendix G.])
7. A program should be in place to track and improve treatment (acutely and at discharge) with ACC/AHA guideline-based Class I therapies.
8. A multidisciplinary STEMI team, including EMS, should review hospital-specific STEMI data on a quarterly basis.
9. SRFs should collect data as requested by the LEMSA. (See "Evaluations and Outcomes," page 43.)
10. The SRF should actively participate in the LEMSA's CQI program for the STEMI System.
11. The SRF should engage in community education about the signs and symptoms of heart attack and the need to call 911.

Procedures

When a LEMSA establishes a STEMI system, it should undertake:

1. Evaluation of hospital capacity within a STEMI system of care.

   LEMSAs should survey or otherwise ascertain the capabilities of hospitals in their regions to determine baseline resources for treating STEMI. One tool that can be used is the AHA/ASA's online survey instrument called Mission: Lifeline™.[29] LEMSAs should use baseline information to create or augment the STEMI system of care within each region.
2. Designation of hospitals as SRCs.

   LEMSAs should establish a process and timeline for the initial designation and continuing designation of SRCs. The designation criteria should be at least as rigorous as those listed above. LEMSAs are encouraged to make their STEMI systems as inclusive as possible, keeping in mind guidelines for minimum recommended procedures performed to maintain expertise. This should provide the highest quality STEMI care to all of California.

3. Designation of hospitals as SRFs.
   LEMSAs should establish a process and timeline for the initial designation and continuing designation of SRFs. The designation criteria should be at least as rigorous as those listed above.
4. Inclusion of non-designated hospitals.
   LEMSAs should encourage all hospitals in their jurisdiction to achieve at least SRF designation so that all Californians can receive optimal STEMI care. At a minimum, hospitals that do not achieve either SRC or SRF designation should: (a) demonstrate that they are giving fibrinolytic therapy to eligible STEMI patients, and (b) participating in the LEMSAs CQI program for STEMI. Some STEMI care advocates have suggested that non-designated hospitals should demonstrate that, as a requirement for hospital licensure, they deliver fibrinolytic therapy appropriately.

EVALUATIONS AND OUTCOMES

The ideal STEMI system of care delivers the most effective and efficient treatment possible to every STEMI patient, regardless of geographic location. Success requires integration of the pre-hospital system with the hospital system and measurement of their joint performance. The ideal system measures overall delay from symptom onset to reperfusion, including key intervals along this time line. These key intervals include time from symptom onset to presentation of the patient at the SRF (if applicable) and also time from symptom onset to presentation at the SRC. These data should be analyzed in the CQI process.

Procedures

1. Engage in CQI
   The success of the hospital component of the STEMI system of care will depend on use of a comprehensive LEMSA-approved CQI program that analyzes objective data to assess and improve the STEMI system of care. The overall goal of a STEMI system of care is to improve quality

of care, thereby improving health outcomes. The following measures are consistent with recommendations from AHA Conference Proceedings,[20] and most data elements can be captured in the NCDR ACTION Registry (see Appendix F).

a. Evaluation of the hospital component of the STEMI system should include assessment of the following structural components.

ED Structure

- Adequately trained and equipped staff to perform efficient evaluation, triage, and treatment.
- Single, standardized STEMI care pathway.

Hospital Structure

- 24/7 PCI capacity.
- Interventional cardiologist and staff capable of arriving at the laboratory within 30 minutes.
- Volume/experience characteristics that meet ACC/AHA PCI guidelines, or a quality assurance mechanism in place to evaluate mortality and other outcomes of PCI to assure timely, safe, and effective PCI.
- For hospitals without cardiac surgery capability on-site, a predefined transfer and management plan for emergency coronary artery bypass surgery.

b. Process:

Data should be collected and reported to the LEMSA on the following hospital process characteristics. It should be the goal to collect these data on 100 percent of STEMI patients. Goals stated below are from ACC/AHA guidelines.[5] With the advice of their STEMI Quality Improvement Committee, the LEMSAs should update these data elements as needed to align them with revisions in national guidelines.

Benchmark: For all measures listed below, the goal is for

100 percent of eligible patients to receive the therapy or intervention described.

ED Process:

- Door-to-ECG time (Goal: Less than 10 minutes). Note: Standardized use of the PH 12-lead-ECG, when available, should also be considered in all EDs.
- Proportion of STEMI patients receiving any reperfusion (PCI or fibrinolytic therapy).
- Door-to-cath lab time (for nontransfer patients) or door-to-disposition time (for patients transferred to STEMI-Receiving Center).
- The proportion of patients ineligible for fibrinolytics but eligible for PCI (e.g., cardiogenic shock, bleeding) who are not transferred acutely from the STEMI-Referral Facility to the SRC.

Hospital Process:

- Door-to-needle time in patients not sent for PCI (Goal: less than 30 minutes).
- D2B time (from arrival at STEMI-Receiving Center to balloon inflation, nontransfer patients) [Goals: Less than 60 minutes for patients with pre-existing diagnosis of STEMI (positive PH 12-lead-ECG with prearrival notification); Less than 90 minutes for patients with no pre-existing diagnosis (walk-in or ambulance transported without positive PH 12-lead-ECG)].
- First hospital D2B time (for transfer patients) (Goal: Less than 90 minutes).
- Total patient ischemic time (symptom onset to balloon) stratified by transfer status (Goal: Less than 120 minutes).
- Proportion of suspected STEMI patients who underwent coronary angiography found not to have STEMI.
- Transfer time (transfer hospital to receiving hospital).

- Proportion of eligible patients receiving currently recommended (Class 1) therapies, including aspirin, beta blockers, statins, angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs), smoking cessation advice/counseling, and cardiac rehabilitation referrals (ACC/AHA Performance Measures).[37]

c. Outcomes

SRCs and SRFs should collect and send to the LEMSA the following data, as applicable. It should be the goal of hospitals to collect these data points on 100 percent of patients.

- In–hospital (risk-adjusted) mortality for STEMI patients.
- In-hospital (risk-adjusted) mortality for PCI patients.
- In-hospital (risk-adjusted) mortality for all myocardial infarction patients (STEMI and non-STEMI).
- Morbidity events (in-hospital stroke, vascular complications) for STEMI patients
- PCI procedural success.

2. Report Quality Improvement Progress

SRCS and SRFs should be required by LEMSA policy to submit data for analysis and review by the LEMSA and the LEMSA-established STEMI CQI Committee to identify opportunities for STEMI system enhancement. (See "System Implementation" section for specifics.)

Community STEMI Education

Because heart disease is the leading cause of death and long-term disability in California.

Goal:

Increase the percentage of people who recognize the signs and symptoms of heart attack and seek care by calling 911.

Community Education

The ability to recognize the signs and symptoms of heart attack is vital to receiving timely treatment and increasing the chance of survival. Information on the recognition of a heart attack and the appropriate response are the key messages for a public education campaign. National, state, and community education should focus on the following critical messages for heart attack:

- The "Chain of Survival" for heart attack and sudden cardiac arrest, includes:
  - Recognition of a cardiac emergency.
  - Calling "911" immediately because "time is muscle" and "EMS brings the emergency room to the patient." (See Appendix H for reasons STEMI patients delay seeking medical treatment.)
  - Initiation of CPR through use of appropriate chest compressions.
  - Use of an automated external defibrillator (AED).
    - Heart disease is the leading cause of death.
    - Heart disease is preventable. People can reduce their chance of developing heart disease by controlling risk factors such as obesity, high blood pressure, and high cholesterol.
    - Signs and symptoms of heart attack.
    - Risk factors for heart disease.
    - Time-sensitive window for EMS/treatment response.

Educational materials and campaigns should be culturally sensitive, language-appropriate, and presented at the literacy level of the intended audience. Materials should particularly target high-risk racial/ethnic groups (e.g., Hispanics, African Americans, and Native Americans) and women. In addition, public education should be presented in a variety of venues throughout the state and community and should be communicated using multiple forms of media.

Procedures

1. Community Benefit Requirements

   Hospitals should be encouraged to satisfy their community benefit requirements by educating people in their service areas about heart disease risk factors, the signs and symptoms of heart attack, and the need to call 911 immediately.

2. Public Education Campaigns

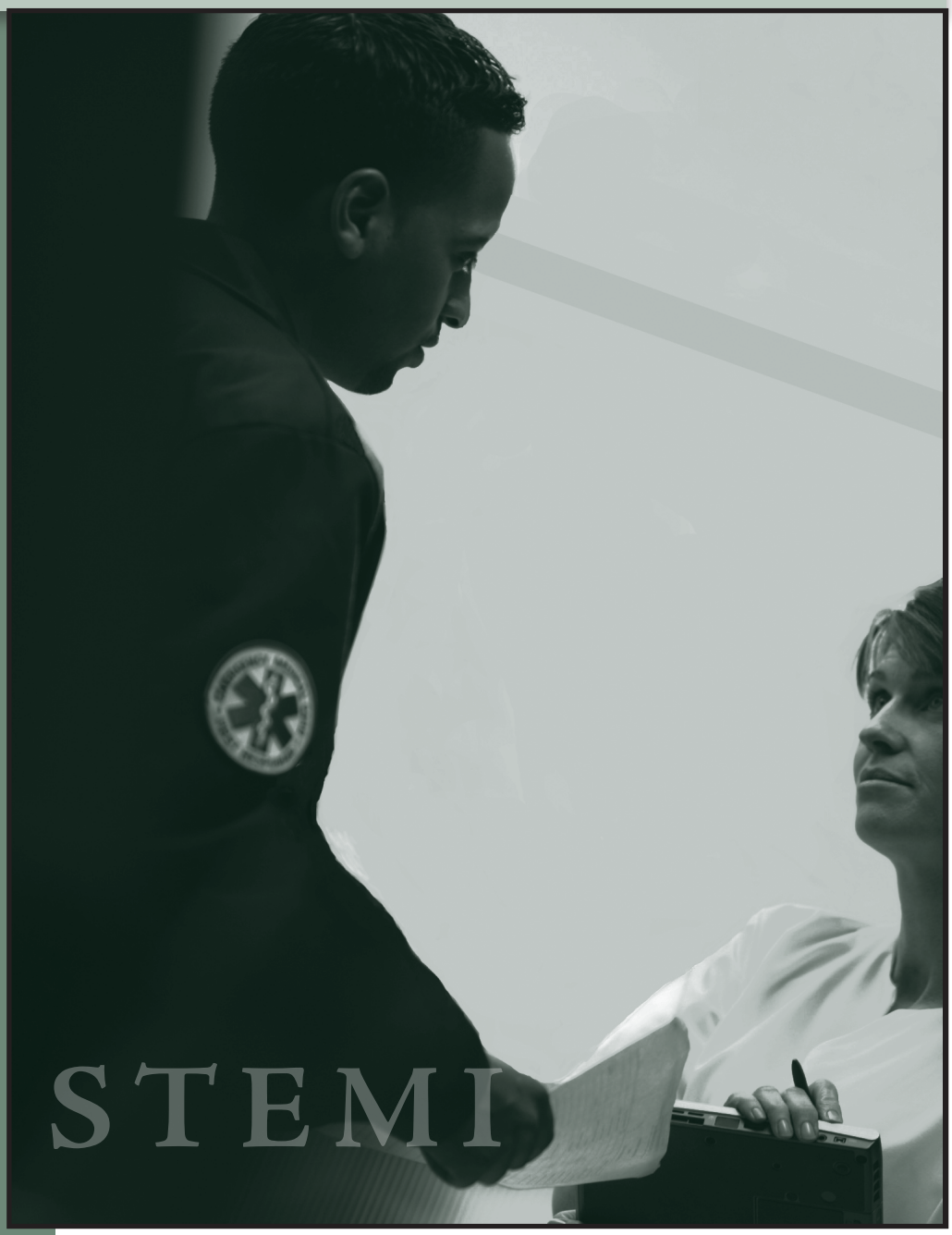
   The ACC, AHA/ASA, CDPH, the EMS Authority, County Health Departments, LEMSAs, SRFs, SRCs, and others should consider conducting and coordinating public education campaigns.

   At the community level, as part of the STEMI system of care:

   a. LEMSAs may require designated STEMI-Receiving Centers to conduct community public education about heart disease risk factors, the signs and symptoms of heart attack, and the need to call 911.
   b. LEMSAs may require designated STEMI-Receiving Centers to educate families of STEMI patients about heart disease risk factors, the signs and symptoms of heart attack, and the need to call 911.
   c. LEMSAs should encourage EMS providers and all hospitals to educate the public about heart disease risk factors, the signs and symptoms of heart attack, and the need to call 911. When possible, EMS providers and hospitals should consider creating educational partnerships.
   d. In conducting, requiring or encouraging these public education campaigns, LEMSAs should seek partnerships with other private and public organizations that are also committed to the prevention and optimum treatment of heart attack.

STEMI System Implementation

Because heart disease is the leading cause of death and long-term disability in California.



Goal:

Strategically link STEMI pre-hospital and hospital services to form regional systems that provide optimal STEMI care.

SYSTEM DEVELOPMENT

Acute heart attack, like trauma and stroke, must be treated rapidly and effectively to minimize the chance of death or long-term disability. It is widely recognized across the nation and in California that the emergent nature of these conditions warrants the development of special systems that link pre-hospital and hospital care strategically so that treatment is possible within a narrow window of time.

Today's STEMI treatment guidelines, promulgated by the ACC and the AHA, recommend:

- Limiting the total ischemic time (the length of time heart muscle is deprived of oxygen) to less than 120 minutes. Total ischemic time is measured as the interval between the first appearance of symptoms and the restoration of blood flood (reperfusion). It includes patient-related delays prior to seeking medical care, and time spent in both the pre-hospital and hospital settings.
- Limiting door-to-needle time (the interval between the patient's arrival at the hospital door and the injection of clot-dissolving medication) to less than 30 minutes, if the reperfusion strategy is fibrinolysis. This interval is spent within the hospital.
- Limiting D2B time (the interval between the patient's arrival at the first hospital door and the deployment of the balloon or device-equivalent) to less than 90 minutes, if the reperfusion strategy is PCI. This interval may include transport time from one hospital to another.

To meet these time limits, the STEMI Work Group recommends an organized and coordinated approach to the way STEMI is addressed in California. It recommends that LEMSAs develop STEMI systems of care based on national and state standards, guidelines, and best practices that strategically integrate pre-hospital and hospital care. Each LEMSA should describe its STEMI system of care within the annual EMS Plan it is required to prepare under California

statute. The STEMI system of Care should appear within the EMS Plan's Facilities and Critical Care Section, Other Critical Care Subsystems, as required by the the EMS Authority. Each LEMSA has STEMI Subsystem planning, coordination, and evaluation authority under the law.

If a LEMSA chooses to develop a STEMI system of care, it should evaluate its unique issues and resources to design a realistic, functional, and comprehensive STEMI system within its jurisdiction. The overarching goal in all cases is to optimize treatment for each STEMI patient's unique situation. LEMSAs should consider answers to the following questions that apply to key variables:

- **Region.** Is it urban/suburban or rural/remote or both?
- **EMS capability.** Is pre-hospital STEMI triage feasible? Is interhospital transfer feasible? Are both feasible?
- **Methods for restoring blood flow to heart muscle (reperfusion).** Are there hospitals in the jurisdiction with the ability to deliver primary PCI in the cardiac catheterization laboratory (cath lab)? What hospitals in the jurisdiction can achieve reperfusion by injecting clot-dissolving medications (fibrinolytics) in the ED?
- **Transport.** What are the options for patient transport? Ground ambulance? Or air transport via helicopter/fixed-wing aircraft? Or both?
- **Triage system.** Is it feasible to develop a pre-hospital STEMI triage system? Is it more realistic to rely on an interhospital transfer system? A pre-hospital triage system identifies STEMI patients in the field using 12-lead ECG and then allows direct transport to the most appropriate care facility.[36] In contrast, an interhospital transfer system relies on STEMI diagnosis in a hospital and then transfer, if necessary, to the most appropriate care facility. Each LEMSA should prioritize development of either a pre-hospital STEMI triage system or an interhospital transfer system. The ultimate goal is to have both systems in each LEMSA, but unique challenges exist with implementation of either system.

All LEMSAs should consider the following:

- There are three pre-hospital ECG interpretation strategies: automated computer algorithm, direct paramedic interpretation, and wireless transmission with physician interpretation.[34]
- It should be expected that approximately 50 percent of STEMI patients call 911, and 50 percent will self-transport to an ED, though regional variation exists.
- Each designated SRC should expect *three* points of entry for STEMI patients: (1) patients can self-transport to the ED, (2) paramedics can bring STEMI patients identified by PH 12-lead-ECG, or (3) the SRC can receive a STEMI patient who is transferred from a designated SRF.
- Each SRF should ideally have only ONE point of entry: a self-transport patient (i.e., walk-in). However, in certain rural regions, it may be more appropriate for EMS to bring a STEMI patient to an SRF for early fibrinolytic therapy, followed by early transfer after fibrinolysis to an SRC. Additionally, SRFs should be prepared with appropriate policies and procedure to treat and transfer ambulance-transported patients with no ECG or a false negative ECG.
- Each LEMSA's STEMI system of care should be specifically designed to avoid extended delays to primary (emergency) PCI (i.e., a D2B time beyond 90 minutes or first medical contact to balloon time beyond 90 minutes) due to prolonged transport times (scene to SRC). Instead, fibrinolytics remain a viable option for many regions, especially in young patients with an anterior myocardial infarction who arrive for medical care within three hours of symptom onset and are at low risk of bleeding.
- In patients treated with fibrinolytics, it should be expected that the affected artery will be opened in approximately two-thirds of patients, and one-third of patients will fail to achieve complete reperfusion.

To assist LEMSAs in their planning through the continuum, the following scenarios are presented as guidance. The scenarios present the various possible combinations of region type and triage system. Based on current guidelines and literature, two strategies are listed for each acenario.

- "PLAN A" represents the ideal strategy to implement whenever possible.
- "PLAN B" represents a reasonable alternative when system constraints prevent use of Plan A.

SCENARIO I. Urban/Suburban systems with pre-hospital STEMI triage for patients who call 911:

- PLAN A = The reperfusion strategy should be prompt primary PCI in the cath lab if D2B time less than or equal to 90 minutes is a realistic systems goal. EMS destination policies should encourage direct transport of all STEMI patients identified by paramedics to an SRC. In general, paramedic transport time is less than 30 minutes from scene to an SRC in urban/suburban areas.
- PLAN B = In rare circumstances, an SRC may give fibrinolytics as a default strategy if primary PCI is unexpectedly unavailable.

SCENARIO II. Urban/Suburban systems with interhospital transfer for patients who self-transport to first hospital:

- PLAN A = Appropriate patients who enter the STEMI system at an SRF should undergo immediate transfer to an SRC for primary PCI if D2B time of 90 minutes or less is a realistic systems goal.
- PLAN B = If D2B is expected to exceed 90 minutes, apply the Pharmaco-Invasive Reperfusion Strategy (Figure 1). Select the pathway that is best tailored to each STEMI patient's unique clinical situation.

SCENARIO III. Rural/Remote systems with pre-hospital STEMI triage for patients who call 911:

Rural and remote systems deserve special consideration, because long transport times due to distance, local geography, or inclement weather are often encountered. Overall system resources and workforce capabilities may be less than that of urban/suburban counterparts.

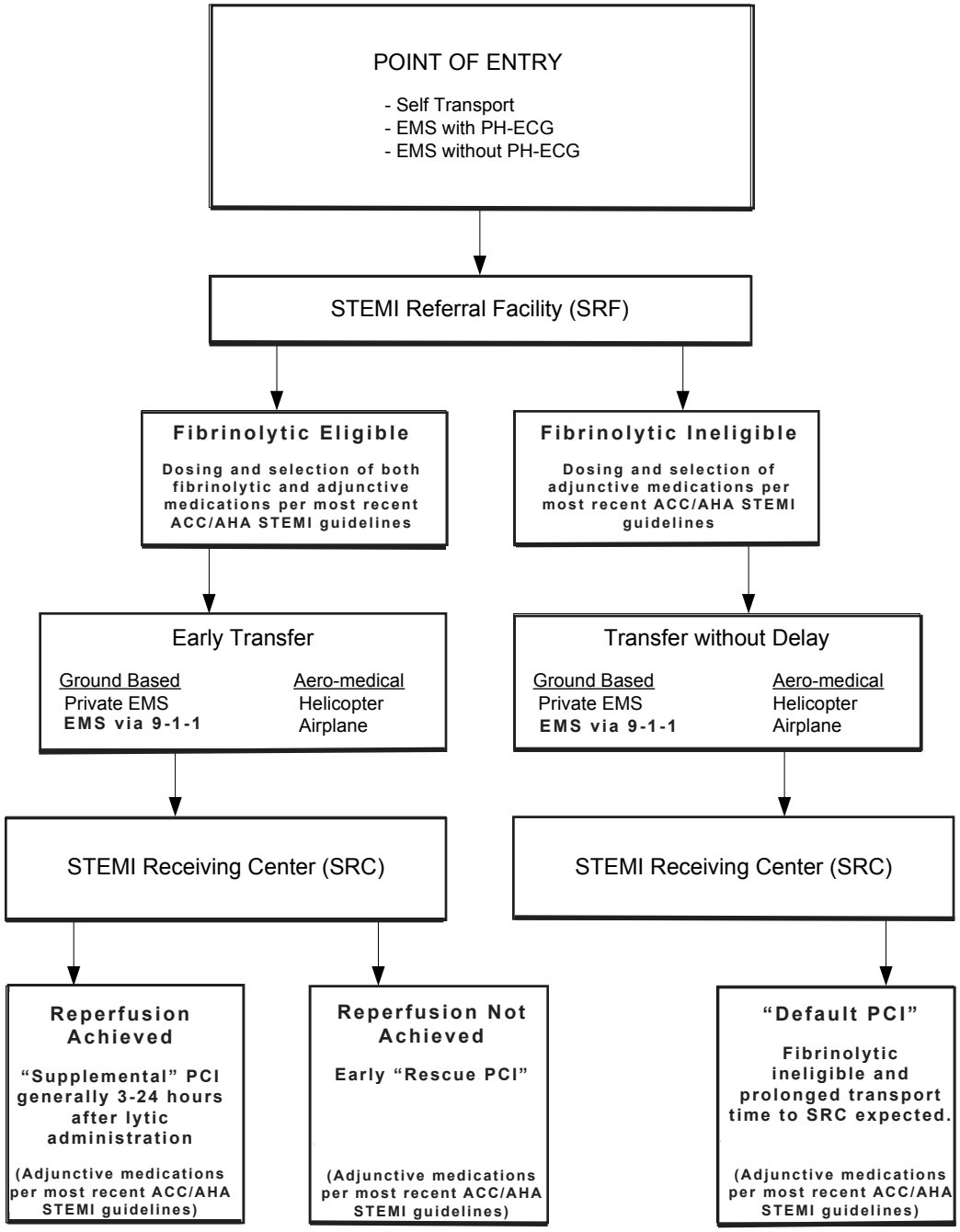
- PLAN A = The reperfusion strategy should be prompt primary PCI in the cath lab if (a) D2B time less than or equal to 90 minutes is a realistic systems goal, and if (b) EMS transport time is expected to be less than 45 minutes. EMS destination policies should encourage direct transport of all STEMI patients identified by paramedics to an SRC. However, ground transport time exceeding 45 minutes could inappropriately leave a rural community without proper paramedic coverage for an extended period.
- PLAN B = If D2B is expected to exceed 90 minutes or if transport time exceeds 45 minutes, apply the Pharmaco-Invasive Reperfusion Strategy (Figure 1). Select the pathway that is best tailored to each STEMI patient's unique clinical situation. This may involve a "hybrid strategy" of pre-hospital triage, initial transport to the nearest SRF, followed by inter-hospital transfer via a second mode of transportation.

SCENARIO IV. Rural/Remote systems with inter-hospital transport for patients who self-transport to first hospital:

- PLAN A = Appropriate patients who enter the STEMI system at an SRF should undergo immediate transfer to an SRC for primary PCI if D2B time of 90 minutes or less is a realistic systems goal.
- PLAN B = If D2B is expected to exceed 90 minutes, apply the Pharmaco-Invasive Reperfusion Strategy (Figure 1). Select the pathway that is best tailored to each STEMI patient's unique clinical situation.

Figure 1: PHARMACO-INVASIVE REPERFUSION STRATEGY

(for use when D2B is expected to exceed 90 minutes[α] and patient does not enter the STEMI system at an SRC)



α The 2008 European (ESC) guidelines provide an alternate interpretation of acceptable primary PCI delays:

- First-medical-contact-to-balloon ≤120 minutes in all cases (Class I-B recommendation).
- However, first-medical-contact-to-balloon ≤90 minutes specified for the subset of STEMI patients presenting early (within 2 hours of symptom onset), with a large infarct (per index ECG), and low bleeding risk (Class I-B recommendation).

SYSTEM OVERSIGHT

LEMSAs with established STEMI systems of care should convene a STEMI CQI Committee, which may be incorporated into a standing Quality Improvement Committee. This Committee should be disclosure-protected under California Evidence Code section 1157.7. The Committee should be led by the LEMSA, and its membership should include the LEMSA medical director; cardiologists; emergency physicians, cath laboratory coordinators and/or directors, and other representatives from all hospitals in the jurisdiction, regardless of SRC, SRF, or non-designated status; EMS providers; and others as determined appropriate by the LEMSA.

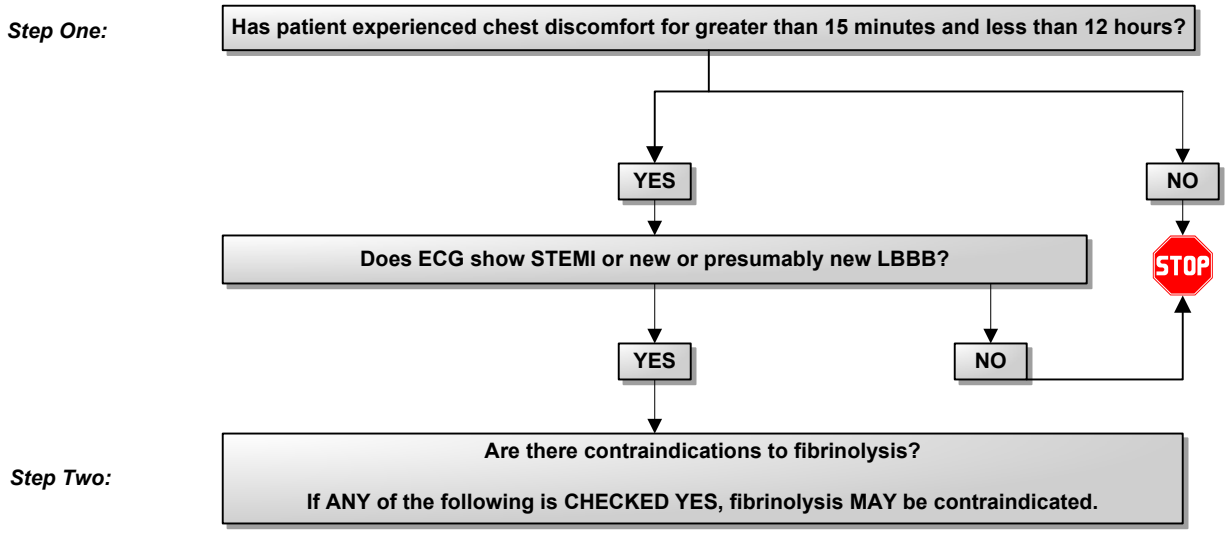
The specific responsibilities of the STEMI Quality Improvement Committee are to:

a. Provide input into the LEMSA's STEMI Subsystem Plan and associated policies such as STEMI patient triage and treatment, SRC and SRF initial and renewal designation standards, patient destination, etc.
b. Provide input into the identification of data elements to be collected and the evaluation process used to review and improve the system. A number of important standardized data elements and benchmarks already exist in ACTION Registry-GWTG (see Appendix G).
c. Review data submitted by SRCs and SRFs per LEMSA requirements in an effort to help the LEMSA identify opportunities for system enhancement.
d. Provide disclosure-protected review of selected STEMI cases such as those involving: outstanding care, educational value, preventable death or disability, non-compliance with system standards, patients who fell outside of system criteria, etc.

Appendices

- A *Fibrinolytic Checklist*
- B *Acute Coronary Syndromes Algorithm*
- C *Recommended Pre-Hospital Data Elements*
- D *Sample LEMSA STEMI Transfer Policy*
- E *Sample SRF Transfer Protocol*
- F *NCDR-ACTION Registry-GWTG*
- G *NCDR-ACTION Registry-GWTG (Limited)*
- H *Reasons Patients Delay Seeking Medical Attention for Symptoms of STEMI*
- I *Map of PCI-Capable Hospitals in California*
- J *References*

FIBRINOLYTIC CHECKLIST FOR STEMI



Systolic BP>180 mm Hg or diastolic BP>110 mm Hg	◯ **YES**	◯ NO
Right vs left arm systolic BP difference > 15 mm Hg	◯ **YES**	◯ NO
History of structural central nervous system disease	◯ **YES**	◯ NO
Stroke >3 hours or <3 months	◯ **YES**	◯ NO
Significant closed head/facial trauma within the previous 3 months	◯ **YES**	◯ NO
Recent (within 6 weeks) major trauma, surgery (including laser eye surgery), GI/GU bleed	◯ **YES**	◯ NO
Bleeding or clotting problem on blood thinners	◯ **YES**	◯ NO
CPR>10 minutes	◯ **YES**	◯ NO
Pregnant female	◯ **YES**	◯ NO
Serious systemic disease (eg, advanced cancer, severe liver or kidney disease)	◯ **YES**	◯ NO

Step Three:

Is patient at high risk?

If ANY of the following is CHECKED YES, consider transfer to PCI facility.

Heart rate ≥100/min AND systolic BP <100 mm Hg	◯ **YES**	◯ NO
Pulmonary edema (rales)	◯ **YES**	◯ NO
Signs of shock (cool, clammy)	◯ **YES**	◯ NO
Contraindications to fibrinolytic therapy	◯ **YES**	◯ NO

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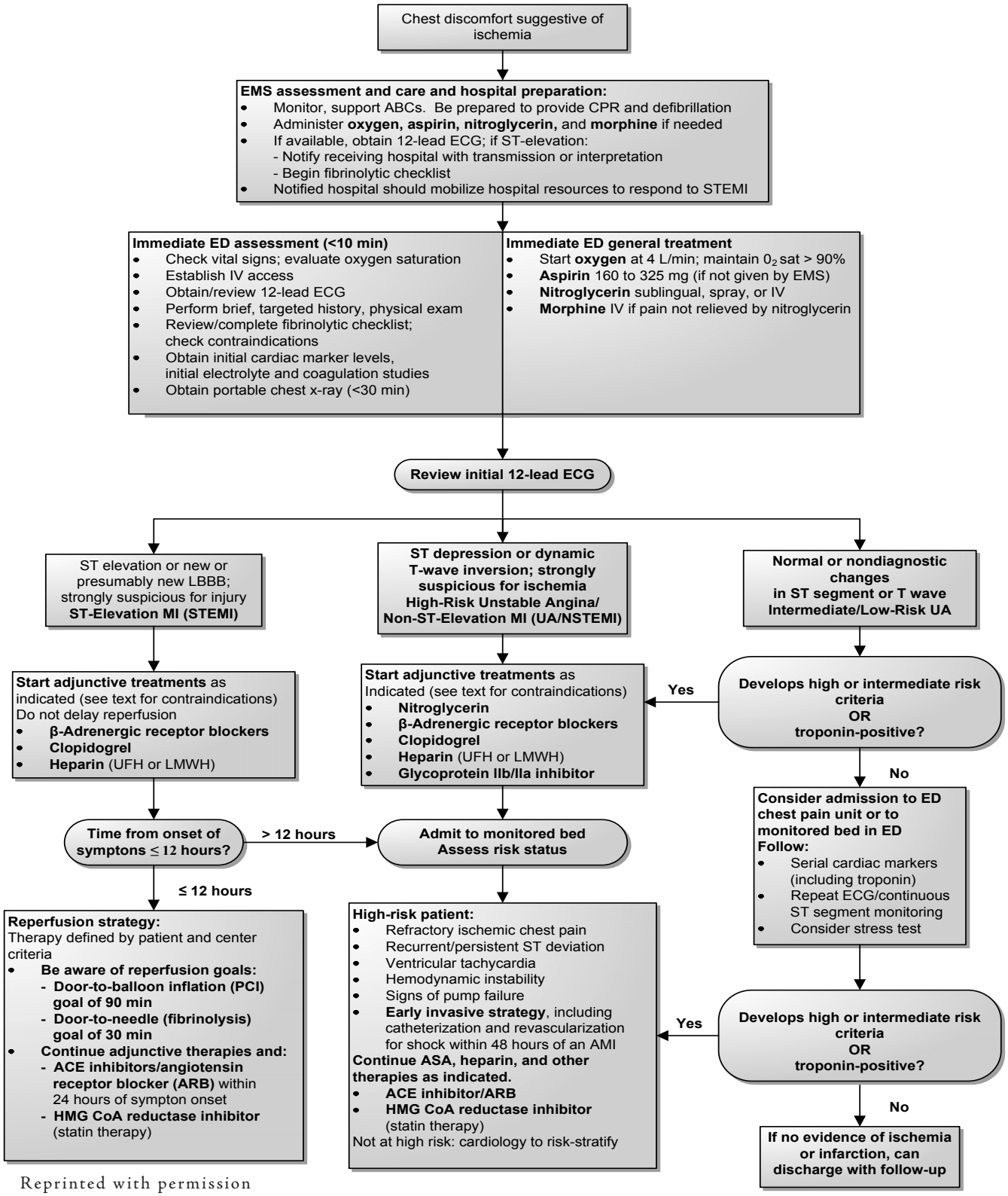
ACUTE CORONARY SYMDROMES ALGORITHM



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RECOMMENDED PRE-HOSPITAL DATA ELEMENTS

EMS DATA ELEMENTS

Process Measure	Data Elements	CEMSIS/NEMSIS
Time from onset of heart attack symptoms to 911 call	Time of onset of heart attack symptoms	Incident or onset Date/Time (NEMSIS E05_01)
	Time of public service answering point (PSAP) call	PSAP call Date/Time (CEMSIS E05_02)
Time from receipt of 911 call to dispatch of Emergency Medical Services (EMS)	Time of PSAP call	PSAP call Date/Time (CEMSIS E05_02)
	Time of EMS dispatch	Unit Notified by dispatch Date/Time (CEMSIS E05_04)
Time from dispatch of EMS to EMS arrival	Time of EMS dispatch	Unit Notified by dispatch Date/Time (CEMSIS E05_04)
	Time of EMS arrival on scene	
Time from EMS arrival to patient contact	Time of EMS arrival on scene	
	Time of first patient contact	Unit arrived at patient Date/Time (CEMSIS E05_07)
On-scene time	Time of EMS arrival on scene	
	Time of EMS departure from scene.	Unit left scene Date/Time (CEMSIS E05_09)
Time from scene to emergency department (ED) door	Time of EMS departure from scene	Unit left scene Date/Time (CEMSIS E05_09)
	Time patient arrived at destination hospital	Patient arrived at destination Date/Time (CEMSIS E05_10)
Total EMS contact time (i.e., time from receipt of the 911 call to arrival at the STEMI-Receiving Center/destination hospital	Time of PSAP call	PSAP call Date/Time (CEMSIS E05_02)
	Time patient arrived at destination hospital	Patient arrived at destination Date/Time (CEMSIS E05_10)
Use of documented fibrinolytic checklist	Fibrinolytic checklist	
EMS responder documentation of time of onset of heart attack symptoms	Time of onset of heart attack symptoms	Incident or onset Date/Time (NEMSIS E05_01)
Pre-hospital 12-lead electrocardiogram (PH 12-lead-ECG) assessment completed	PH 12-lead-ECG	Procedure (CEMSIS E19_03) Cardiac Rhythm (CEMSIS E14_03) Cardiac Rhythm on arrival at destination (CEMSIS E11_11)
Documentation of pre-arrival notification of receiving facility	Pre-arrival notification	
Documentation of medication given	Medication given	Medication given (CEMSIS E18_03)
Code of dispatch, transport/return	Code of dispatch	Response mode to scene (CEMSIS E02_20)
	Code of transport/return	
Air transport	Yes or No	
Provider's primary impression	Primary impression	CEMSIS E09_15
Transport to STEMI-Receiving Center involved bypassing a closer hospital	Yes or No	

STEMI SYSTEM ELEMENTS

Process Measure	Data Elements	CEMSIS/NEMSIS
For transfer patients, on-scene time at sending hospital	Patient time of arrival at first hospital (transferring hospital)	Patient arrived at destination Date/Time (CEMSIS E05_10)
	Patient time of departure from first hospital (transferring hospital)	
For transfer patients, interfacility transport time	Patient time of departure from first hospital transferring hospital	
	Patient time of arrival at second hospital (receiving hospital)	
For transfer patients, mode of arrival to first hospital	EMS, private car, etc.	
Percent/proportion of patients routed to designated STEMI-Receiving Center	Total number of STEMI patients routed via EMS to a STEMI-Receiving Center	
	Total number of STEMI patients admitted to STEMI-Receiving Center	
Continuous quality improvement (CQI) assessment of EMS training needs		
CQI assessment of resource failures (e.g., the frequency with which STEMI-Receiving Centers must divert patients due to nonoperating equipment)		
Over/Under Triage – Patients entered into the STEMI system by EMS assessment who did/did not receive a hospital diagnosis of STEMI	Total number of patients routed via EMS to a STEMI-Receiving Center	
	Total number of STEMI patients routed via EMS (ICD-9-CM principal diagnosis related to STEMI)	
Triage protocol specific for STEMI	Yes or No	
Destination – STEMI-Receiving Center	Yes or No	Reason for choosing destination (CEMSIS E20_16)

SAMPLE LEMSA STEMI-TRANSFER POLICY

COUNTY OF VENTURA HEALTH CARE AGENCY	EMERGENCY MEDICAL SERVICES POLICIES AND PROCEDURES

Policy Title: "Code STEMI:"
Inter-facility Transfer of Patients with STEMI for PCI

I. PURPOSE: To define the "Code STEMI" process by which patients with a STEMI are transferred to a STEMI Receiving Center (SRC) for emergency percutaneous coronary intervention (PCI).

II. AUTHORITY: Health and Safety Code, Sections 1797.220 and 1798. California Code of Regulations, Title 22, Sections 100147 and 100169.

III. DEFINITIONS:

A. STEMI: ST Segment Elevation Myocardial Infarction.

B. STEMI Receiving Center (SRC): an acute care hospital with percutaneous coronary intervention (PCI) services that has been designated according to VC EMS Policy 430.

C. STEMI Referral Hospital (SRH): an acute care hospital in Ventura County that meets the requirements for a receiving hospital in VC EMS Policy 420 and is not designated as a STEMI Receiving Center according to VC EMS Policy 430.

D. PCI: Percutaneous Coronary Intervention.

IV. POLICY:

A. STEMI Referral Hospitals will:

1. Assemble and maintain a "STEMI Pack" in the emergency department to contain all of the following:

a. Checklist with phone numbers of Ventura County SRCs.

b. Preprinted template order sheet with recommended prior-to-transfer treatments. Treatment guidelines will be developed with input from the SRH and SRC cardiologists.

c. Patient Consent/Transfer Forms.

d. Treatment summary sheet.

e. Ventura County EMS Code STEMI data entry form.

2. Have policies, procedures, and a quality improvement system in place to minimize door-to-ECG and STEMI-Dx-to-transfer times.

3. Establish policies and procedures to make personnel available to accompany the patient during the transfer to the SRC. These policies will include patient criteria for requiring an RN to accompany patient.

B. Ambulance Dispatch Center will:

1. Respond to a "Code STEMI" transfer request by immediately dispatching the closest available ALS ambulance to the requesting SRH.

C. Ambulance Companies

1. Ambulance Companies will:
   a. Respond immediately upon request for "Code STEMI" transfer.
   b. Staff all ambulances with a minimum of one paramedic who has been trained in the use of intravenous heparin and nitroglycerine drips, and the pump being used, according to VC EMS Policy 722.
2. Transports performed according to this policy are not to be considered an interfacility transport as it pertains to ambulance contract compliance.

D. STEMI Receiving Centers will:

1. Maintain accurate status information on ReddiNet regarding the availability of a cardiac catheterization lab.
2. Publish a single phone number, that is answered 24/7, to receive notification of a STEMI transfer.
3. Immediately upon initial notification by a transferring physician at an SRH, accept in transfer all patients who have been diagnosed with a STEMI and who, in the judgment of the transferring physician, require urgent PCI.
4. Authorize the emergency physician on duty to confirm the acceptance in transfer of any patient with a STEMI.
5. Establish an internal communications plan that assures the immediate notification of all necessary individuals, including the cardiac catheterization services staff and on-call interventional cardiologist, of the transfer.
6. Adopt procedures to make an ICU/CCU bed available or to make alternate arrangements for post-PCI care.

V. PROCEDURE:

A. Upon diagnosis of STEMI, and after discussion with the patient, the SRH will:

1. Determine availability of the SRC by checking ReddiNet.
2. Immediately call the Ventura County Fire Communication Center at 805-384-1500 for an ambulance.

3. Identify their facility to the dispatcher and advise they have a Code STEMI transfer to [SRC].
4. After calling for ambulance, the SRH transferring physician will notify the SRC emergency physician of the transfer.
5. Perform all indicated diagnostic tests and treatments.
6. Complete transfer consent, treatment summary, and Code STEMI data forms.
7. Include copies of the ED face sheet and demographic information.
8. Arrange for one or more healthcare staff, as determined by the clinical status of the patient, to accompany the patient to the SRC.
   a. If, because of unusual and unanticipated circumstances, no healthcare staff is available for transfer, the SRH may contact the responding ambulance company to make a paramedic or EMT available.
   b. If neither the SRH or ambulance company has available personnel, a CCT transfer may be requested.
9. Contact SRC for nurse report at the time of, or immediately after, the ambulance departs.

B. Upon request for "Code STEMI" transfer, the dispatch center will dispatch the closest ALS ambulance and verbalize "MEDxxx Code STEMI from [SRH]". The SRC will be denoted in the Incident Comments, which will display on the Mobile Data Computer (MDC). If a unit does not have an operational MDC, the SRH will advise the responding ambulance personnel of the SRC.

C. Upon notification, the ambulance will respond Code (lights and siren) and the ambulance personnel will notify their ambulance company supervisor of the "Code STEMI" transfer.

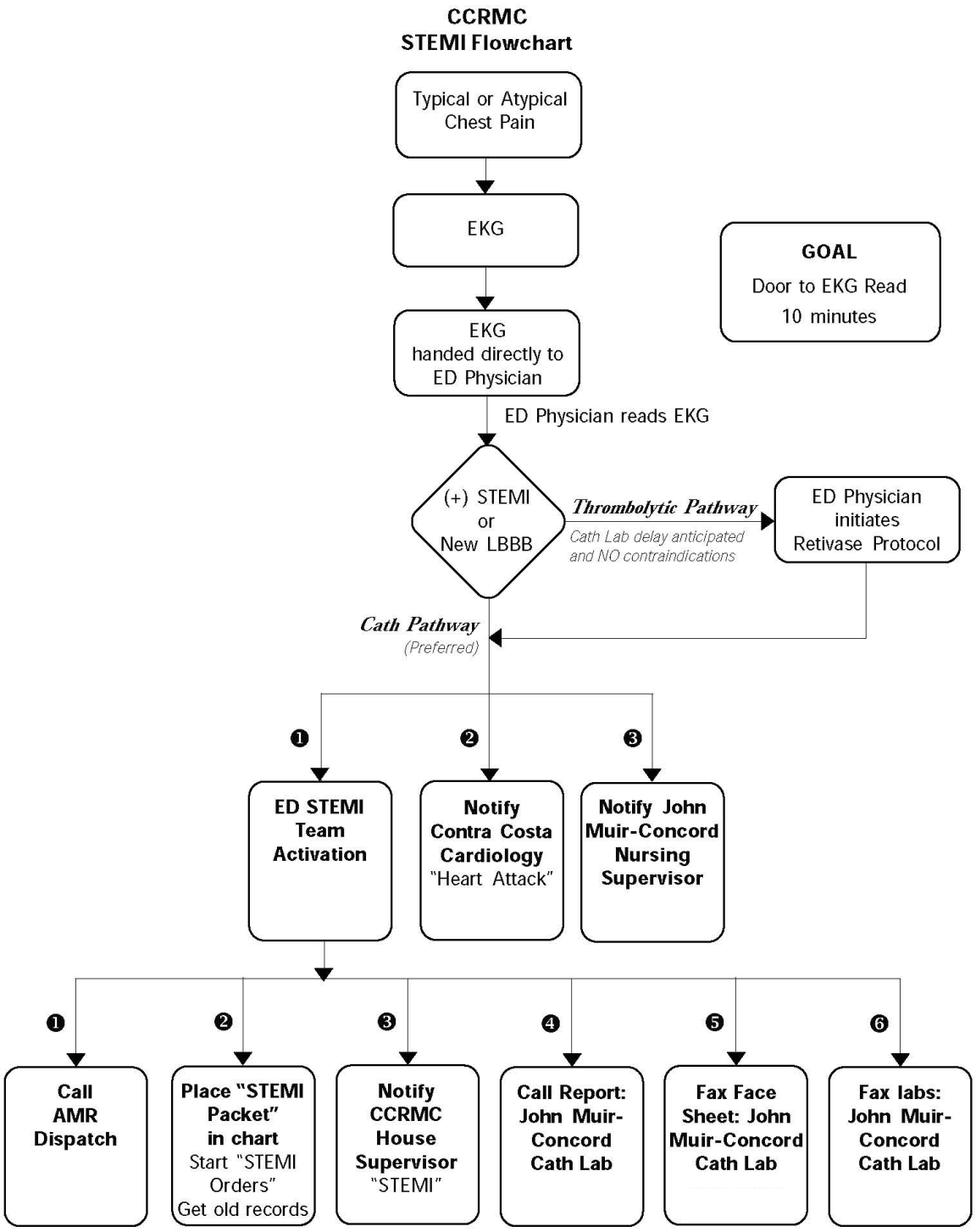
D. Ambulance units will remain attached to the incident and FCC will track their dispatch, en-route, on scene, en-route hospital, at hospital, and available times.

E. The patient shall be urgently transferred without delay. Every effort will be made to minimize on-scene time.
   1. All forms should be completed prior to ambulance arrival.
   2. Any diagnostic test results may be relayed to the SRC at a later time.
   3. Intravenous drips may be discontinued or remain on the ED pump.
   4. Ambulance personnel will place defibrillation pads on the patient.

F. Upon notification, the SRC will notify the interventional cardiologist and cardiac catheterization staff, who will respond immediately and prepare for the PCI procedure.

G. The SRH and SRC shall review all STEMI transfers within 24 hours for appropriate and timely care and to identify opportunities for improvement. Results will be reviewed and discussed at the Countywide EMS STEMI CQI Committee.

SAMPLE STEMI-REFERRAL FACILITY TRANSFER PROTOCOL*



*Created by John Muir Medical Center for Contra Costa County Hospital

E

Code STEMI Protocol:

Multiple steps need to be done simultaneously by ED Nursing and Medical Team

1. Greet Emergency Patient – on patient arrival
   - 1.1. What brings you to the Emergency Department today?
   - 1.2. We need your identification – do you have a driver's license or other photo identification for us to register you to be seen today?
2. Triage Nurse – within 10 minutes of patient arrival
   - 2.1. If patient presentation either typical or atypical chest pain, immediate ECG to be performed within 5 minutes of presentation to the ED
   - 2.2. Once ECG completed, hand the ECG to an emergency physician for interpretation within 5 minutes
3. Emergency Physician
   - 3.1. Read ECG, date, time and sign it
   - 3.2. Medical Decision – Does the Patient have a STEMI?
   - 3.3. If yes, Notify the ED Charge Nurse/Clerk of Internal ED ONLY Code STEMI Activation
   - 3.4. Notification of Contra Costa Cardiology STAT
   - **3.5. Determine whether RN and/or MD needs to accompany patient during transport**
     - 3.5.1. Inform ED Charge Nurse
     - 3.5.2. In cases of respiratory, electrical or hemodynamic instability, and/or if the patient requires drips, and/or blood, a RN or a physician will accompany the patient
4. Charge Nurse
   - 4.1. Immediate transport of emergency patient from triage to critical care emergency treatment bed
   - 4.2. Assign two emergency RNs to care for the patient; provide STEMI Medical Orders / Transfer Orders
   - 4.3. Initiate Patient Transfer
     - 4.3.1. Notification of John Muir-Concord Nursing Supervisor
   - 4.4. Assist the attending emergency nursing staff to prepare the patient for immediate stabilization and transfer.
5. ED Clerk
   - 5.1. Print Code STEMI Bundled Protocol, Order Set and Transfer Documentation Forms
   - 5.2. Hand-Off above to ED Charge Nurse
   - 5.3. Initiate Patient Transfer via AMR / Emergency Paramedic Ambulance for Urgent Transfer
     - 5.3.1. Call AMR dispatch
     - 5.3.2. If there is any delay with this request, hang up and call 911 to request a paramedic ambulance.
   - 5.4. Prepare patient's emergency record for transport.
   - 5.5. Notification of CCRMC's Medical Center Supervisor
6. Charge Nurse / ED Clerk
   - 6.1. Complete Code STEMI Event Check List / Audit Tool

CONTRA COSTA HEALTH SERVICES
CONTRA COSTA REGIONAL MEDICAL CENTER
EMERGENCY DEPARTMENT

STEMI
EVENT CHECK LIST / AUDIT TOOL
(NOT TO BE FILED IN MEDICAL RECORD)

Addressograph or print name & MR# _____

Emergency Patients w/ + STEMI & Transfer to John Muir-Concord

Date: _____ Charge Nurse: _____

	Event	Responsibility	Time		Notes
	Patient Arrival Time	Triage Nurse			
	ECG (1st) Read	Charge Nurse			
	Activation of ED Code STEMI	ED Physician			
	Notification of Contra Costa Cardiology	ED Physician	Page	Call	
	Request AMR & Request Emergency Paramedic / Urgent Transport to John Muir-Concord	ED Clerk	Call	Arrival	
	Notification of John Muir-Concord Nursing Supervisor	Charge Nurse			
	Level of Care during Transport—*Does Emergency RN need to accompany Paramedics?*	ED Physician Charge Nurse			If RN needed, assign attending RN and reassign other ED patients to relieve the attending RN.
	Complete Transfer Form	Charge Nurse ED Physician			
	Notify John Muir-Concord Cath Lab	Attending RN			
	Fax Face Sheet to John Muir-Concord Cath Lab	ED Clerk			
	Complete the Patient's ED Record & Photocopy for Transport Team	Attending RN			
	Emergency Patient Departure	Attending RN			
	Fax lab results to John Muir-Concord Cath Lab	ED Clerk			

E

CONTRA COSTA HEALTH SERVICES
CONTRA COSTA REGIONAL MEDICAL CENTER
STEMI
(ST SEGMENT ELEVATION
MYOCARDICAL INFARCTION)
TRANSFER ORDERS

Date _____

Weight (kg) _____

Allergies_____

☒ **EKG completed**
☐ **STEMI confirmed by MD?**

Indication for STAT transfer to John Muir-Concord Cardiac Catheterization Lab:

☐ 1. STEMI symptoms **< 12 hours** and ST elevation in 2 or more contiguous leads or left bundle branch block that is new or of unknown duration.
☐ 2. Onset of symptoms **between 12-24 hours and** any of the following:
a. Ongoing chest pain or MI symptoms **plus** persistent ST elevation
b. Severe heart failure
c. Hemodynamic or electrical instability

ORDERS

☒ Aspirin 325 mg chew and swallow unless anaphylaxis in past (If history of anaphylaxis, give Plavix)

☐ Clopidogrel (Plavix) 300 mg PO (aspirin alternative IF history of anaphylaxis to aspirin)
☒ O2 nasal cannula
☒ IV x 2 (left arm preferred)
☒ CARP, CBC, PT/PTT/INR, COMP
☐ If inferior MI, consider right-sided EKG
☐ Morphine 2 mg IV push. Repeat _____ as needed for pain or SOB.
☐ NTG 0.4 mg SL every 5 min x 3, PRN chest pain.
Hold for SBP < 100 (Caution in Inferior/RV MI)
Consider nitroglycerin paste only if hypertensive and not an inferior MI with RV involvement.
☐ hePARIN 60 units/kg IV bolus. Give _____ **mg IV now.**

_____

Noted by Date & Time Physician Signature Date & Time

ED TRANSFER CERTIFICATION & ACKNOWLEDGEMENT FORM

Sending Physician: _____**Diagnosis:** ST Elevation Myocardial Infarction _____
Accepting Physician: _____ **(name) Time Transfer Accepted:** _____

TRANSPORT VEHICLE
- ☐ Ambulance Unit
- ☐ Helicopter
- ☐ Fixed wing aircraft
- ☐ With MD and/or RN

LEVEL OF CARE
- ☐ ALS
- ☐ BLS
- ☐ RN
- ☐ CCI
- ☐ RT
- ☐ _ _____

Special equipment/needs: _____
Medical Orders during transit:
_____

PHYSICIAN CERTIFICATE: Based upon the information available to me at the time of transfer, I certify that (1) the medical benefits reasonably expected from the provision of appropriate medical treatment at another facility outweigh the risk of transfer to the patient or unborn child/children. (2) for nonmedical transfer, that, within reasonable medical probability, the transfer creates no medical hazard to the patient.

RISKS OF TRANSFER
- ☐ Increased discomfort during transit
- ☐ Accidents or delays during transit
- ☐ Possible worsening of condition in transit
- ☐ Other: _____
  _____
  _____
  _____
  _____

BENEFITS / REASON FOR TRANSFER
- ☐ Specialized equipment not available at this hospital. List equipment: Cardiac Catheterization Laboratory
- ☐ Medical services not available at this hospital. List services: Coronary angiography: Angioplasty and stenting; Intraaortic balloon pump if needed.
- ☐ Patient request ☐ Prior agreement made for transfer is in compliance with prepaid health plan or insurance coverage.
- ☐ Other _____

☐ The patient has no reasonable risk of deterioration in condition from or during transfer.

Physician Signature _____ **Date** _____ **Time**
_____

Sending Hospital: Contra Costa Regional Medical Center ☐ED ☐Bed _____ ☐Other
Destination Hospital: John Muir-Concord Medical Center ☐ED ☐Bed _____ ☐**Cardiac Cath Laboratory**
Name of accepting MD: _____
Vitals on arrival: Date: _____/_____/_____ **Time:** _____:_____**a.m./p.m.** T_____ P_____ R_____ BP_____
Vitals at time of transfer: Date: _____/_____/_____ **Time:** _____:_____**a.m./p.m.** T_____ P_____ R_____ BP_____
IV Running? ☐ None IV Solution _____ IV Meds _____

	Sent	Not Done		Sent	Not Done		Sent	Not Done
Lab work:	☐	☐	X-rays:	☐	☐	Other_____	☐	☐
Chart:	☐	☐	EKG:	☐	☐		**Sent**	**Fax'd**
Nurse notes:	☐	☐	Transfer form:	☐	☐	Dictation:	☐	☐

Report to receiving nurse: Time _____ **Name** _____ **RN Sig.** _____ **Charge RN**_____

_____

CONSENT FOR TRANSFER I acknowledge that my (patient's) medical condition has been explained to me, I understand that it is recommended that I (patient) be transferred to the above facility. The benefits of transfer, risks of transfer, and risks of not transferring and reason for transfer have been explained to me and fully understand them. I understand that I have a right to receive medical screening, examination and evaluation by a physician without regard to my ability to pay prior to any transfer from this hospital. In the event that you have a concern regarding the hospital's conduct, contact: Hospital Administration or California Depatment of Health Services, 850 Marina Bay Pkwy., Bldg. P, Richmond.

☐ I hereby ***CONSENT TO TRANSFER*** and authorize the hospital to provide copies of my (patient's) medical records and to exchange medical information necessary for medical care and to comply with any law or regulation.

☐ I hereby ***REFUSE TRANSFER*** to the named hospital.

_____
Patient/Parent Signature **Date** **Time** **Witness**

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A. Demographics

Last Name[2000]: | **First Name**[2010]: | **Middle Name**[2020]: | **Birth Date**[2050]:

SSN[2030]: ☐SSN N/A[2031] | **Patient ID**[2040]: | **Other ID**[2045]:

Race: (check all that apply) ☐ White[2070] ☐ Black/African American[2071] ☐ Asian[2072] ☐ American Indian/Alaskan Native[2073] ☐ Native Hawaiian/Pacific Islander[2074]

Hispanic or Latino Ethnicity[2076]: O No O Yes

Sex[2060]: O Male O Female

B. Admission

Patient Zip Code[3000]: ☐ Zip Code N/A[3001]

Means of Transport to First Facility[3100]: O Self/Family O Ambulance O Mobile ICU O Air

→ **If** Ambulance **or** Mobile ICU **or** Air, **Pre-Arrival 1st Med. Contact Date/Time**[3105, 3106]: _____ ☐ Time Estimated[3107]

Transferred from Outside Facility[3110]: O No O Yes → **If** Yes, **Means of Transfer**[3115]: O Ambulance O Mobile ICU O Air

→ **If** Yes, **Arrival at Outside Facility Date/Time**[3120, 3121]: _____ ☐ Time Estimated[3122]

→ **If** Yes, **Transfer from Outside Facility Date/Time**[3125, 3126]: _____ ☐ Time Estimated[3127]

→ **If** Yes, **Name of Transferring Facility/AHA Number**[3150, 3151]: _____

Your Facility

Arrival Date/Time[3200, 3201]:

Admission Date[3210]:

Location of First Evaluation[3220]: O ED O Cath Lab O Other

→ **If** ED, **Transfer Out Date/Time**[3221, 3222]: _____

Insurance Payors: (check all that apply) ☐ Private Health Insurance[3300] ☐ Medicare[3301] ☐ Medicaid[3302] ☐ Military Health Care[3303] ☐ State-Specific Plan (non-Medicaid)[3304] ☐ Indian Health Service[3305] ☐ Non-US Insurance[3306] ☐ None[3307]

HIC #[3320]:

C. Cardiac Status On First Medical Contact

Symptom Onset Date/Time[4000, 4001]: ☐ Time Estimated[4002] ☐ Time Not Available[4003]

First ECG Obtained[4010]: O Pre-Hospital (e.g. ambulance) O After 1st hosp. arrival | **First ECG Date/Time**[4020, 4021]:

STEMI or STEMI Equivalent[4030]: O No O Yes → **If** Yes, **ECG Findings**[4040]: O ST elevation O LBBB (new or presumed new) O Isolated posterior MI

→ **If** Yes, **STEMI or STEMI Equivalent First Noted**[4041]: O First ECG O Subsequent ECG

→ **If** Subsequent ECG, **Subsequent ECG with STEMI or STEMI Equivalent Date/Time**[4042, 4043]: _____

→ **If** No, **Other ECG Findings**[4044]: (demonstrated within first 24 hours of medical contact) O New or presumed new ST depression O New or presumed new T-Wave inversion O Transient ST elevation lasting < 20 minutes O None

Heart Failure[4100]: O No O Yes | **Heart Rate**[4120]: (bpm) | **Systolic BP**[4130]: (mmHg)

Cardiogenic Shock[4110]: O No O Yes | **Cocaine Use**[4115]: O No O Yes

D. History and Risk Factors

Height[5000]: (cm)

Weight[5010]: (kg)

Current/Recent Smoker (< 1 year)[5020]: O No O Yes

Hypertension[5030]: O No O Yes

Dyslipidemia[5040]: O No O Yes

Currently on Dialysis[5050]: O No O Yes

Chronic Lung Disease[5060]: O No O Yes

Diabetes Mellitus[5070]: O No O Yes

→ **If** Yes, **Diabetes Therapy**[5071]: O None O Diet O Oral O Insulin O Other

Prior MI[5080]: O No O Yes

Prior Heart Failure (previous Hx)[5090]: O No O Yes

Prior PCI[5100]: O No O Yes

→ **If** Yes, **Most Recent PCI Date**[5101]: _____

Prior CABG[5110]: O No O Yes

→ **If** Yes, **Most Recent CABG Date**[5111]: _____

Atrial Fibrillation or Flutter (past 2 wks)[5120]: O No O Yes

Cerebrovascular Disease[5130]: O No O Yes

→ **If** Yes, **Prior Stroke**[5131]: O No O Yes

Peripheral Arterial Disease[5140]: O No O Yes

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E. MEDICATIONS

Oral Medications

Medication	Home Meds	Medications Administered in First 24 Hours (Up to 24 hours after first medical contact*)	Medications Prescribed At Hospital Discharge (do not code for patients who die or are AMA or are transferred to another hospital)
Aspirin[6000- 6021]	O No O Yes	O No O Yes O Contraindicated O Blinded → **If** Yes, **Start Date/Time:** _____ * Note: code "Yes" for Aspirin if admin. 24 hrs before or after first medical contact	O No O Yes O Contraindicated O Blinded → **If** Yes, **Dose:** _____mg
Clopidogrel[6050- 6072]	O No O Yes	O No O Yes O Contraindicated O Blinded → **If** Yes, **Start Date/Time:** _____ → **If** Yes, **Dose:** _____mg	O No O Yes O Contraindicated O Blinded → **If** Yes, **Dose:**_____mg → **If** Yes, **Recommended Duration:** _____mos.
Ticlopidine[6100-6122]	O No O Yes	O No O Yes O Contraindicated O Blinded → **If** Yes, **Start Date/Time:** _____ → **If** Yes, **Dose:** _____mg	O No O Yes O Contraindicated O Blinded → **If** Yes, **Dose:**_____mg → **If** Yes, **Recommended Duration:** _____mos.
Prasugrel[6150-6172]	O No O Yes	O No O Yes O Contraindicated O Blinded → **If** Yes, **Start Date/Time:** _____ → **If** Yes, **Dose:** _____mg	O No O Yes O Contraindicated O Blinded → **If** Yes, **Dose:**_____mg → **If** Yes, **Recommended Duration:** _____mos.
Warfarin[6200-6220]	O No O Yes		O No O Yes O Contraindicated O Blinded
Beta Blocker[6250-6270]	O No O Yes	O No O Yes O Contraindicated O Blinded → **If** Yes, **Start Date/Time:**	O No O Yes O Contraindicated O Blinded
ACE Inhibitor[6300-6320]	O No O Yes	O No O Yes O Contraindicated O Blinded	O No O Yes O Contraindicated O Blinded
Angiotensin Receptor Blocker[6350-6370]	O No O Yes	O No O Yes O Contraindicated O Blinded	O No O Yes O Contraindicated O Blinded
Aldosterone Blocking Agent[6400-6420]	O No O Yes	O No O Yes O Contraindicated O Blinded	O No O Yes O Contraindicated O Blinded
Statin[6450-6470]	O No O Yes	O No O Yes O Contraindicated O Blinded	O No O Yes O Contraindicated O Blinded
Non-Statin Lipid-Lowering Agent[6500- 6520]	O No O Yes	O No O Yes O Contraindicated O Blinded	O No O Yes O Contraindicated O Blinded

Intravenous and Subcutaneous Medications

Category	Medications Administered
GP IIb/IIIa Inhibitor[6800] (any time during this hospitalization)	O No O Yes O Contraindicated O Blinded → **If** Yes, **Medication Type**[6801]: O Eptifibatide O Tirofiban O Abciximab → **If** Yes, **Start Date/Time**[6802, 6803]: _____ → **If** Yes, **Stop Date/Time**[6804, 6805]: _____ → **If** Eptifibatide **or** Tirofiban**, Dose**[6806]: O Full O Reduced O Other
Anticoagulant[6850]	O No O Yes O Contraindicated O Blinded → **If** Yes, **Medication Type(s):** ☐ IV Unfractionated Heparin[6851] **Start Date/Time**[6852, 6853]: _____ **Initial Bolus** [6854]: O No O Yes → **If** Yes, **Initial Bolus Dose**[6855]: _____units **Initial Infusion**[6856]: O No O Yes → **If** Yes, **Initial Infusion Dose**[6857]: _____units/hr ☐ Enoxaparin (LMWH)[6860] **Start Date/Time**[6861, 6862]: _____ **Initial SubQ Dose**[6863]: _____mg **Initial IV Bolus**[6864]: O No O Yes **Injection Freq.**[6865]:O q12hr O q24hr O None ☐ Dalteparin (LMWH)[6870] **Start Date/Time**[6871, 6872]: **Initial SubQ Dose**[6873]: units ☐ Bivalirudin[6875] **Start Date/Time**[6876, 6877]: ☐ Fondaparinux[6880] **Start Date/Time**[6881, 6882]: ☐ Argatroban[6885] **Start Date/Time**[6886, 6887]: ☐ Lepirudin[6890] **Start Date/Time**[6891, 6892]:

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F. Procedures and Tests

Non-invasive Stress Testing[7000]: O No O Yes → **If** Yes, **Date**[7001]: | **LVEF**[7010]: % ☐ LVEF Not Assessed[7011]

Diagnostic Coronary Angiography[7020]: O No O Yes → **If** Yes, **Angiography Date/Time**[7021, 7022]: _____

→ **If** Yes, **Best Estimate of Coronary Anatomy:**

Coronary Territory	Coronary Artery Stenosis	Coronary Territory	Coronary Artery Stenosis
Left Main[7023]:	% ☐ Not Available[7024]	CIRC, OMs, LPDA & LPL Branches[7029]:	% ☐ Not Available[7030]
Prox. LAD [7025]:	% ☐ Not Available[7026]	RCA, RPDA, RPL, AM Branches[7031]:	% ☐ Not Available[7032]
Mid/Distal LAD, Diag Branches[7027]:	% ☐ Not Available[7028]	Ramus[7033]:	% ☐ Not Available[7034]

→ **If** No, **Diagnostic Cath Contraindication**[7035]: O No O Yes

PCI[7100]: O No O Yes

→ **If** Yes, **Cath Lab Arrival Date/Time**[7101, 7102]: _____

→ **If** Yes, **First Device Activation Date/Time**[7103, 7104]: _____

→ **If** Yes, **Stent(s) Placed**[7105]: O No O Yes → **If** Yes, **Stent Type(s):** ☐ Bare metal stent[7106] ☐ Drug eluting stent[7107] ☐ Other[7108]

→ **If** Yes, **PCI Indication**[7109]: O Immediate, primary PCI for STEMI O Rescue PCI (after failed full-dose lytics for STEMI)

O PCI for NSTEMI O Stable, successful reperfusion for STEMI, or completed infarction post-STEMI O Other

→ **If** Immediate, Primary PCI for STEMI, **Non-System Reason for Delay in PCI**[7110]:

O Difficult vascular access
O Patient delays in providing consent for the procedure
O Other
O Cardiac arrest and/or need for intubation before PCI
O Difficulty crossing the culprit lesion during the PCI procedure
O None

CABG[7200]: O No O Yes

→ **If** Yes, **CABG Date/Time**[7201, 7202]: _____

G. Reperfusion Strategy (Immediate Reperfusion)

Was Patient a **Reperfusion Candidate**[8000] O No O Yes

→ **If** No, **Primary Reason**[8010]:

O Non-compressible vascular puncture(s)
O Active bleeding on arrival or within 24 hours
O Known bleeding diathesis
O Recent bleeding within previous 4 weeks
O History of CVA
O Recent surgery/trauma
O Intracranial neoplasm, AV malformation, or aneurysm
O Severe uncontrolled hypertension
O No ST elevation/LBBB
O ST elevation resolved
O MI diagnosis unclear
O MI symptoms onset >12 hours
O Chest pain resolved
O No chest pain
O Suspected aortic dissection
O Significant closed head or facial trauma within previous 3 months
O Prior allergic reaction to thrombolytics or IV contrast
O Current use of oral anticoagulants
O Active peptic ulcer
O Quality of life decision
O Comorbid disease
O Traumatic CPR that precludes thrombolytics
O Anatomy not suitable to primary PCI
O Spontaneous reperfusion (documented by cath only)
O Patient/family refusal
O DNR at time of treatment decision
O Ischemic stroke w/in 3 months except acute ischemic stroke w/in 3 hours
O Any prior intracranial hemorrhage
O Pregnancy
O Other (Not Listed)

→ **If** Yes, **Thrombolytics**[8020]: O No O Yes → **If** Yes, **Strength of Dose**[8021]: O Full dose O Reduced dose

→ **If** Yes, **Type of Thrombolytics**[8022]: O Tenecteplase O Alteplase O Reteplase O Streptokinase O Other

→ **If** Yes, **Dose Start Date/Time**[8023, 8024]: _____

→ **If** Yes, **Non-System Reason for Delay**[8025]: O No O Yes

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H. In-Hospital Clinical Events

Reinfarction[9000]: O No O Yes
→ **If** Yes, **Date**[9001]: _____

Cardiogenic Shock[9010]: O No O Yes
→ **If** Yes, **Date**[9011]: _____

Heart Failure[9020]: O No O Yes
→ **If** Yes, **Date**[9021]: _____

CVA/Stroke[9030]: O No O Yes
→ **If** Yes, **Date**[9031]: _____
→ **If** Yes, **Hemorrhagic**[9032]: O No O Yes

Suspected Bleeding Event[9040]: O No O Yes
→ **If** Yes, **Suspected Bleeding Event Date**[9041]: _____
→ **If** Yes, **Bleeding Event Location** (check all that apply):
☐ Access Site[9042] ☐ Retroperitoneal[9043] ☐ GI[9044] ☐ GU[9045] ☐ Other[9046]
→ **If** Yes, **Surgical Procedure or Intervention Required**[9047]: O No O Yes

RBC/Whole Blood Transfusion[9050]: O No O Yes
→ **If** Yes, **First Transfusion Date**[9051]: _____
→ **If** Yes, **CABG-Related Transfusion**[9052]: O No O Yes

I. Laboratory Results

Cardiac Markers

Positive Cardiac Markers Within First 24 Hours[10000]: O No O Yes

	Troponin	CK-MB
Initial	**Collected**[10010]: O No O Yes – I O Yes – T → **If** Yes, **Date/Time**[10011, 10012]: _____ → **If** Yes, **Value**[10013]: _____ (ng/mL) → **URL**[10014]: _____	**Collected**[10020]: O No O Yes → **If** Yes, **Date/Time**[10021, 10022]: _____ → **If** Yes, **Value**[10023]: _____O IU/L O % O (mg/mL)/IU O ng/mL → **ULN**[10025]: _____
Peak	**Collected**[10030]: O No O Yes – I O Yes – T → **If** Yes, **Date/Time**[10031, 10032]: _____ → **If** Yes, **Value**[10033]: _____ (ng/mL) → **URL**[10034]: _____	**Collected**[10040]: O No O Yes → **If** Yes, **Date/Time**[10041, 10042]: _____ → **If** Yes, **Value**[10043]: _____O IU/L O % O (mg/mL)/IU O ng/mL → **ULN**[10045]: _____

Creatinine

Initial	**Collected**[10100]: O No O Yes → **If** Yes, **Date/Time**[10101, 10102]: _____ → **If** Yes, **Value**[10103]: _____ (mg/dL)	**Peak**	**Collected**[10110]: O No O Yes → **If** Yes, **Date/Time**[10111, 10112]: _____ → **If** Yes, **Value**[10113]: _____ (mg/dL)

Hemoglobin

Initial	**Collected**[10150]: O No O Yes → **If** Yes, **Date/Time**[10151, 10152]: _____ → **If** Yes, **Value**[10153]: _____ (g/dL)	**Lowest**	**Collected**[10200]: O No O Yes → **If** Yes, **Date/Time**[10201, 10202]: _____ → **If** Yes, **Value**[10203]: _____ (g/dL)

Initial Hemoglobin A1c

Collected[10250] O No O Yes → **If** Yes, **Date/Time**[10251, 10252]: → **If** Yes, **Value**[10253]: %

Initial INR

Collected[10300]: O No O Yes → **If** Yes, **Date/Time**[10301, 10302]: → **If** Yes, **Value**[10303]:

Lipids (mg/dL)

Panel Performed[10350]: O No O Yes → **If** Yes, **Date/Time**[10351, 10352]: _____ ☐ Value Out of Range[10360]
→ **If** Yes, **TC**[10353]: _____ → **If** Yes, **HDL**[10354]: _____ → **If** Yes, **LDL**[10355]: _____ → **If** Yes, **Triglycerides**[10356]: _____

Initial BNP	Initial NT-proBNP
Collected[10400]: O No O Yes → **If** Yes, **Value**[10401]: (pg/mL)	**Collected**[10405]: O No O Yes → **If** Yes, **Value**[10406]: (pg/mL)

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J. Discharge

Discharge Date[11000]:

Comfort Measures Only[11010]: O No O Yes

Enrolled in Clinical Trial During Hospitalization[11020]: O No O Yes

Discharge Status[11100]: O Alive O Deceased

→ **If** Alive, **Smoking Counseling**[11101]: O No O Yes

→ **If** Alive, **Dietary Modification Counseling**[11102]: O No O Yes O N/A

→ **If** Alive, **Exercise Counseling**[11103]: O No O Yes O Ineligible

→ **If** Alive, **Cardiac Rehabilitation Referral**[11104]: O No O Yes O Ineligible

→ **If** Alive, **Discharge Location**[11105]: O Home O Extended care/transitional care unit O Other hospital O Nursing home O Hospice O Other O Left against medical advice (AMA)

→ **If** Other Hospital, **Transfer Time**[11106]: _____

→ **If** Other Hospital, **Transfer for PCI**[11107]: O No O Yes

→ **If** Other Hospital, **Transfer for CABG**[11108]: O No O Yes

→ **If** Deceased, **Cause of Death**[11150]: O Cardiac O Non-cardiac

→ **If** Deceased, **Time of Death**[11151]: _____

K. Optional Elements (For AMI Core Measure Reporting only)

Point of Origin[12000]:

- O Non-health care facility
- O Clinic
- O Transfer from a hospital (different facility)
- O Transfer from a skilled nursing facility (SNF) or intermediate care facility (ICF)
- O Transfer from another health care facility
- O Emergency room
- O Court/law enforcement
- O Information not available
- O D: Transfer from one distinct unit of the hospital to another distinct unit of the same hospital resulting in a separate claim to the Payor
- O E: Transfer from ambulatory surgery center
- O F: Transfer from hospice and is under a hospice plan of care or enrolled in a hospice program

Transfer from Another ED[12010]: O No O Yes

CMS Comfort Measures Timing[12020]: O Day 0 or 1 O Day 2 or after O Timing unclear O Not documented/UTD

Principal Diagnosis Code[12090]: **Principal Procedure Code**[12100]: **Date**[12101]:

Other Diagnosis Code(s)[12110-12]:

Other Procedure Code(s)[12120-21]: **Date(s)**[12122-23]:

Physician 1[12130]: **Physician 2**[12131]:

CMS Discharge Status[12140]:

- O D/C – Home or self care
- O D/C – Short term general hospital
- O D/C – To a skilled nursing facility (SNF) with Medicare certification in anticipation of covered skilled care
- O D/C – Intermediate care facility
- O D/C – Institution not defined elsewhere in this code list
- O D/C – Home under care of organized home health service organization in anticipation of covered skilled care
- O Left against medical advice or discontinued care
- O Expired
- O Expired in a medical facility (e.g. hospital, SNF, ICF, or freestanding hospice)
- O D/C – Federal health care facility
- O Hospice – Home
- O Hospice – Medical facility
- O D/C – Hospital-based Medicare-approved swing bed
- O D/C – Inpatient rehabilitation facility (IRF) including rehabilitation-distinct part units of a hospital
- O D/C – Medicare-certified long term care hospital (LTCH)
- O D/C – Nursing facility certified under Medicaid but not certified under Medicare
- O D/C – To a psychiatric hospital or a psychiatric-distinct part unit of a hospital
- O D/C – Critical access hospital (CAH)

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A. Demographics

Last Name[2000]: | **First Name**[2010]: | **Middle Name**[2020]: | **Birth Date**[2050]:

SSN[2030]: ☐SSN N/A[2031] | **Patient ID**[2040]: | **Other ID**[2045]: | **Sex**[2060]: O Male O Female

Race: (check all that apply) ☐ White[2070] ☐ Black/African American[2071] ☐ Asian[2072] ☐ American Indian/Alaskan Native[2073] ☐ Native Hawaiian/Pacific Islander[2074]

Hispanic or Latino Ethnicity[2076]: O No O Yes

Patient Zip Code[3000]: ☐ Zip Code N/A[3001]

B. Admission

Means of Transport to First Facility[3100]: O Self/Family O Ambulance O Mobile ICU O Air

→ **If** Ambulance **or** Mobile ICU **or** Air, **Pre-Arrival 1st Med. Contact Date/Time**[3105, 3106]: _____ ☐ Time Estimated[3107]

Transferred from Outside Facility[3110]: O No O Yes → **If** Yes, **Means of Transfer**[3115]: O Ambulance O Mobile ICU O Air

→ **If** Yes, **Arrival at Outside Facility Date/Time**[3120, 3121]: _____ ☐ Time Estimated[3122]

→ **If** Yes, **Transfer from Outside Facility Date/Time**[3125, 3126]: _____ ☐ Time Estimated[3127]

→ **If** Yes, **Name of Transferring Facility/AHA Number**[3150, 3151]: _____

Your Facility

Arrival Date/Time[3200, 3201]: | **Admission Date**[3210]: | **HIC #**[3320]:

Insurance Payors: (check all that apply) ☐ Private Health Insurance[3300] ☐ Medicare[3301] ☐ Medicaid[3302] ☐ Military Health Care[3303] ☐ State-Specific Plan (non-Medicaid)[3304] ☐ Indian Health Service[3305] ☐ Non-US Insurance[3306] ☐ None[3307]

C. Cardiac Status On First Medical Contact

Symptom Onset Date/Time[4000, 4001]: ☐ Time Estimated[4002] ☐ Time Not Available[4003]

First ECG Obtained[4010]: O Pre-Hospital (e.g. ambulance) O After 1st hosp. arrival | **First ECG Date/Time**[4020, 4021]:

STEMI or STEMI Equivalent[4030]: O No O Yes → **If** Yes, **ECG Findings**[4040]: O ST elevation O LBBB (new or presumed new) O Isolated posterior MI

→ **If** Yes, **STEMI or STEMI Equivalent First Noted**[4041]: O First ECG O Subsequent ECG

→ **If** Subsequent ECG, **Subsequent ECG with STEMI or STEMI Equivalent Date/Time**[4042, 4043]: _____

→ **If** No, **Other ECG Findings**[4044]: (demonstrated within first 24 hours of medical contact) O New or presumed new ST depression O New or presumed new T-Wave inversion O Transient ST elevation lasting < 20 minutes O None

Heart Failure[4100]: O No O Yes | **Cardiogenic Shock**[4110]: O No O Yes | **Heart Rate**[4120]: (bpm) | **Systolic BP**[4130]: (mmHg)

D. History and Risk Factors

Weight[5010]: (kg)

Current/Recent Smoker (< 1 year)[5020]: O No O Yes

Currently on Dialysis[5050]: O No O Yes

Hypertension[5030]: O No O Yes

Diabetes Mellitus[5070]: O No O Yes

Peripheral Arterial Disease[5140]: O No O Yes

Cerebrovascular Disease[5130]: O No O Yes

→ **If** Yes, **Prior Stroke**[5131]: O No O Yes

J. Discharge

Discharge Date[11000]:

Comfort Measures Only[11010]: O No O Yes

Enrolled in Clinical Trial During Hospitalization[11020]: O No O Yes

Discharge Status[11100]: O Alive O Deceased

→ **If** Alive, **Smoking Counseling**[11101]: O No O Yes

→ **If** Alive, **Exercise Counseling**[11103]: O No O Yes O Ineligible

→ **If** Alive, **Cardiac Rehabilitation Referral**[11104]: O No O Yes O Ineligible

→ **If** Alive, **Discharge Location**[11105]: O Home O Extended care/transitional care unit O Other hospital O Nursing home O Hospice O Other O Left against medical advice (AMA)

→ **If** Other Hospital, **Transfer Time**[11106]: _____

→ **If** Other Hospital, **Transfer for PCI**[11107]: O No O Yes

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E. Medications

Oral Medications

Medication	Medications Administered in First 24 Hours (Up to 24 hours after first medical contact*)	Medications Prescribed At Hospital Discharge (do not code for patients who die or are AMA or are transferred to another hospital)
Aspirin[6010- 6020]	O No O Yes O Contraindicated O Blinded → **If** Yes, **Start Date/Time:** _____ * Note: code "Yes" for Aspirin if admin. 24 hrs before or after first medical contact	O No O Yes O Contraindicated O Blinded
Clopidogrel[6060- 6070]	O No O Yes O Contraindicated O Blinded → **If** Yes, **Start Date/Time:** _____ → **If** Yes, **Dose:** _____mg	O No O Yes O Contraindicated O Blinded
Ticlopidine[6110-6120]	O No O Yes O Contraindicated O Blinded → **If** Yes, **Start Date/Time:** _____	O No O Yes O Contraindicated O Blinded
Prasugrel[6160-6170]	O No O Yes O Contraindicated O Blinded → **If** Yes, **Start Date/Time:** _____	O No O Yes O Contraindicated O Blinded
Warfarin[6220]		O No O Yes O Contraindicated O Blinded
Beta Blocker[6260-6270]	O No O Yes O Contraindicated O Blinded	O No O Yes O Contraindicated O Blinded
ACE Inhibitor[6320]		O No O Yes O Contraindicated O Blinded
Angiotensin Receptor Blocker[6370]		O No O Yes O Contraindicated O Blinded
Aldosterone Blocking Agent[6420]		O No O Yes O Contraindicated O Blinded
Statin[6470]		O No O Yes O Contraindicated O Blinded

Intravenous and Subcutaneous Medications

GP IIb/IIIa Inhibitor[6800] (any time during this hospitalization)	O No O Yes O Contraindicated O Blinded → **If** Yes, **Medication Type**[6801]: O Eptifibatide O Tirofiban O Abciximab → **If** Yes, **Start Date/Time**[6802, 6803]: _____
Anticoagulant[6850]	O No O Yes O Contraindicated O Blinded → **If** Yes, **Medication Type(s):** □ IV Unfractionated Heparin[6851] □ Enoxaparin (LMWH)[6860] □ Dalteparin (LMWH)[6870] □ Bivalirudin[6875] □ Fondaparinux[6880] □ Argatroban[6885] □ Lepirudin[6890]

F. Procedures and Tests

Diagnostic Coronary Angiography[7020]: O No O Yes | **LVEF**[7010]: % □ LVEF Not Assessed[7011]

PCI[7100]: O No O Yes

→ **If** Yes, **Cath Lab Arrival Date/Time**[7101, 7102]: _____

→ **If** Yes, **First Device Activation Date/Time**[7103, 7104]: _____

→ **If** Yes, **Stent(s) Placed**[7105]: O No O Yes → **If** Yes, **Stent Type(s):** □ Bare metal stent[7106] □ Drug eluting stent[7107] □ Other[7108]

→ **If** Yes, **PCI Indication**[7109]: O Immediate, primary PCI for STEMI O Rescue PCI (after failed full-dose lytics for STEMI)
O PCI for NSTEMI O Stable, successful reperfusion for STEMI, or completed infarction post-STEMI O Other

→ **If** Immediate, Primary PCI for STEMI, **Non-System Reason for Delay in PCI**[7110]:

O Difficult vascular access
O Patient delays in providing consent for the procedure
O Other
O Cardiac arrest and/or need for intubation before PCI
O Difficulty crossing the culprit lesion during the PCI procedure
O None

CABG[7200]: O No O Yes

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ACTION Registry®-GWTG™

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Acute Coronary Treatment and Intervention Outcomes Network Registry

G. Reperfusion Strategy (Immediate Reperfusion)

Was Patient a **Reperfusion Candidate**[8000] O No O Yes

→ **If** Yes, **Thrombolytics**[8020]: O No O Yes

→ **If** Yes, **Dose Start Date/Time**[8023, 8024]: _____

→ **If** Yes, **Non-System Reason for Delay**[8025]: O No O Yes

H. In-Hospital Clinical Events

Reinfarction[9000]:	O No O Yes	**Suspected Bleeding Event**[9040]:	O No O Yes
Cardiogenic Shock[9010]:	O No O Yes	**RBC/Whole Blood Transfusion**[9050]:	O No O Yes
Heart Failure[9020]:	O No O Yes	**CVA/Stroke**[9030]:	O No O Yes
		→ **If** Yes, **Hemorrhagic**[9032]:	O No O Yes

I. Laboratory Results

Positive Cardiac Markers Within First 24 Hours[10000]: O No O Yes

Troponin		Creatinine	
Initial	**Collected**[10010]: O No O Yes – I O Yes – T → **If** Yes, **Value**[10013]: _____ (ng/mL) → **URL**[10014]: _____	**Initial**	**Collected**[10100]: O No O Yes → **If** Yes, **Value**[10103]: _____ (mg/dL)
Hemoglobin		**Lipids** (mg/dL)	
Initial	**Collected**[10150]: O No O Yes → **If** Yes, **Value**[10153]: _____ (g/dL)	**Panel Performed**[10350]: O No O Yes → **If** Yes, **LDL**[10355]: _____	

K. Optional Elements (For AMI Core Measure Reporting only)

Point of Origin[12000]:

- O Non-health care facility
- O Clinic
- O Transfer from a hospital (different facility)
- O Transfer from a skilled nursing facility (SNF) or intermediate care facility (ICF)
- O Transfer from another health care facility
- O Emergency room
- O Court/law enforcement
- O Information not available
- O D: Transfer from one distinct unit of the hospital to another distinct unit of the same hospital resulting in a separate claim to the Payor
- O E: Transfer from ambulatory surgery center
- O F: Transfer from hospice and is under a hospice plan of care or enrolled in a hospice program

Transfer from Another ED[12010]: O No O Yes

CMS Comfort Measures Timing[12020]: O Day 0 or 1 O Day 2 or after O Timing unclear O Not documented/UTD

Principal Diagnosis Code[12090]: **Principal Procedure Code**[12100]: **Date**[12101]:

Other Diagnosis Code(s)[12110-12]:

Other Procedure Code(s)[12120-21]: **Date(s)**[12122-23]:

Physician 1[12130]: **Physician 2**[12131]:

CMS Discharge Status[12140]:

- O D/C – Home or self care
- O D/C – Short term general hospital
- O D/C – To a skilled nursing facility (SNF) with Medicare certification in anticipation of covered skilled care
- O D/C – Intermediate care facility
- O D/C – Institution not defined elsewhere in this code list
- O D/C – Home under care of organized home health service organization in anticipation of covered skilled care
- O Left against medical advice or discontinued care
- O Expired
- O Expired in a medical facility (e.g. hospital, SNF, ICF, or freestanding hospice)
- O D/C – Federal health care facility
- O Hospice – Home
- O Hospice – Medical facility
- O D/C – Hospital-based Medicare-approved swing bed
- O D/C – Inpatient rehabilitation facility (IRF) including rehabilitation-distinct part units of a hospital
- O D/C – Medicare-certified long term care hospital (LTCH)
- O D/C – Nursing facility certified under Medicaid but not certified under Medicare
- O D/C – To a psychiatric hospital or a psychiatric-distinct part unit of a hospital
- O D/C – Critical access hospital (CAH)

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REASONS PATIENTS DELAY SEEKING MEDICAL ATTENTION FOR SYMPTOMS OF STEMI[1]

- Expected a dramatic presentation
- Thought symptoms were not serious/would go away
- Took a "wait and see" approach to the initial symptoms that included self-evaluation, self-treatment, and reassessment until "certain"
- Tended to attribute symptoms to other chronic conditions (e.g., arthritis, muscle strain) or common illnesses (influenza)
- Lacked awareness of the benefits of rapid action, reperfusion treatment, or of the importance of calling EMS/911 for acute MI symptoms.
- Expressed fear of embarrassment if symptoms turned out to be a false alarm; reluctant to "bother" EMS unless "really sick"; need permission from others such as health care providers, spouses, family to take action.
- Few ever discussed symptoms, responses, or actions for a heart attack in advance with family or providers
- Stereotypes of who is at risk for a heart attack. Not perceived at risk if:
  - Young and healthy (especially men)
  - A woman
  - Under a doctor's care or making lifestyle changes (especially men with risk factors).

Based on findings from Finnegan et al. Preventive Medicine 2000;31:205-13 (114)

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PCI-CAPABLE HOSPITALS IN CALIFORNIA (Self-reported)

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Recommendations for the Early Management of Adults with ST-Elevation Myocardial Infarction (STEMI)

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