Bypassing the Emergency Department to Improve the Process of Care for
ST-Elevation Myocardial Infarction: Necessary but Not Sufficient

Running title: Antman; Shortening the time to reperfusion for STEMI

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Journal Subject Codes: Atherosclerosis:[87] Coronary circulation, Ethics and policy:[100]
Health policy and outcome research, Thrombosis:[172] Arterial thrombosis, Diagnostic
testing:[29] Coronary imaging: angiography/ultrasound/Doppler/CC

Key words: systems of care, ST-segment elevation myocardial infarction, Editorial, myocardial
infarction, acute coronary syndrome, systems of care
The last several decades have been marked by dramatic advances in the management of patients with an acute decompensation of ischemic heart disease. A now common phrase in our clinical lexicon is acute coronary syndrome (ACS), which is further subdivided into presentations with and without ST-segment elevation on the ECG – thus dividing ACS presentations into ST-segment elevation MI (STEMI) and unstable angina/non-ST-segment MI (UA/NSTEMI).  
Given the time urgency of restoring antegrade flow in the culprit coronary artery in STEMI, it is understandable that a major focus of clinical research has been defining the optimal reperfusion regimen – first with fibrinolysis and later catheter-based interventions.

In 2006, an AHA Consensus Statement was published outlining the fact that, at the time, only a minority of patients with STEMI in the United States received primary percutaneous coronary intervention (PCI) and, in those who did, fewer than 40% were treated within 90 minutes after hospital arrival. 2 The AHA convened an acute MI Advisory Working Group that agreed the next step in the process after the initial consensus statement was to develop an implementation plan to establish a system of care to increase the number of patients with STEMI who received timely access to primary PCI. Within a year, a conference was held with representation from all the key stakeholders, the success of early model STEMI systems was reviewed, and the AHA launched Mission:Lifeline, an initiative to improve the quality of care and outcomes for patients with STEMI and to improve the healthcare system readiness and response to STEMI. 3

Several remarkable achievements of Mission:Lifeline over the last six years are worth noting. A robust website exists that is the central clearing house to learn more about Mission:Lifeline, get the latest news on hot topics, access tools and resources, and register/locate a system of care for STEMI. 4 As of June 2013, a total of 680 STEMI systems were registered...
across the U.S. – covering 67% of our nation’s population.

In an earlier report published in 2012 when 381 unique systems involving 899 PCI hospitals from 47 states responded to a survey via the Mission.Lifeline website, the organizational characteristics of the collaborative efforts to provide timely reperfusion for STEMI in the U.S. were summarized. Of note, at the time, 55% of systems reported the availability of 12 lead ECGs in their EMS vehicles. The 12 lead ECG was transmitted to a hospital in 68% of systems. Interpretation of the tracing was performed by paramedics in 63% and by computer in 34% of systems. When the prehospital ECG revealed a STEMI, the catheterization laboratory was activated via ED notification in 78% of systems; 19% involved a cardiologist for activation and 15% permitted an EMT to activate the laboratory directly.

In a complementary quality improvement effort, the American College of Cardiology initiated the D2B Alliance in 2006 to improve door-to-device times in PCI-capable hospitals caring for patients with STEMI. The National Cardiovascular Data Registry (NCDR) Cath PCI Registry was used as the data collection tool for the D2B Alliance. The goal was for participating hospitals to treat 75% of their nontransfer STEMI patients within 90 minutes or less of hospital arrival. Hospitals participating in the D2B quality improvement project did show progressive increases in the proportion of patients treated within 90 minutes with attainment of the 75% goal by 2009. To examine national trends in D2B, in particular asking whether improvements were noted in hospitals outside of registry settings, data submitted to the Centers for Medicare and Medicaid Services from 2005 through 2010 were analyzed. The median hospital D2B declined from 97 minutes in 2005 to 64 minutes in 2010.

Since “time is muscle,” it is a reasonable question to ask whether there are any components of the system delay that can be minimized to help shorten the time to reperfusion.
In this issue, Bagai and colleagues provide a report from *Mission:Lifeline* on 12,581 STEMI patients. The data were collected from hospitals in the National Cardiovascular Data Registry Acute Coronary Treatment and Intervention Outcomes Network Registry-Get With The Guidelines (ACTION REGISTRY-GWTG) program. The analysis focused on STEMI patients with a pre-hospital ECG who were transported by EMS directly to a PCI-capable hospital. The purpose of the study was to evaluate the frequency of bypassing the Emergency Department (ED) and admitting the patient directly to the catheterization laboratory. During the period between 2008 and 2011, ED-bypass occurred in 10.5% of patients. The use of ED-bypass increased slightly from 8.5% in 2008 to 11.5% in 2011. Of note, about 50% of the STEMI patients were transported by EMS but the use of pre-hospital ECG recordings increased from 47% to 55%. STEMI patients who were handled via the ED-bypass pathway were less likely to have had a prior MI, to present in cardiogenic shock, or have a non-system reason for delay in PCI (e.g. cardiac arrest, difficulty with consent, need for intubation). Bypassing the ED was associated with a 20 minute saving in the time from first medical contact (FMC) to device activation (68 minutes versus 88 minutes when the ED was not bypassed). Significantly more STEMI patients who bypassed the ED had a FMC-device time ≤90 minutes (80.7%) compared with those who underwent evaluation in the ED (53.7%). The median duration of time spent in the ED was 30 minutes. Of note, presentation during working hours was highly correlated with ED bypass (Odds Ratio 7.58 [6.47-8.89] p<0.0001). It is quite logical that ED bypass occurred more frequently during regular working hours, since that is when it is more likely that staff members are present in the catheterization laboratory to care for an acutely ill patient with STEMI.

Despite the shortening of FMC-device time associated with ED bypass, there was no
difference in the adjusted in-hospital mortality compared with ED evaluation. How can we reconcile the fact that ED bypass was associated with a lower system delay but did not translate into improved in-hospital outcomes? Terkelsen et al. report from Western Denmark (55% of that nation’s population) that between 2002 and 2008, a total of 6209 STEMI patients were admitted for primary PCI at one of three high-volume PCI centers, in 95% of cases being transported by a single EMS system.\(^9\) They found that for every 1 hour increase in system delay, the hazard ratio (HR) for long-term mortality (median follow-up of 3.4 years) in Cox regression analysis was 1.10 (1.04-1.16), \(p=0.002\). It is possible that the lack of a signal of mortality benefit from ED bypass in the report from Bagai was too small an impact of system delay (30 minutes) and too short a follow-up period (in hospital outcomes).

Other epidemiologic considerations may also confound the ability to detect a signal of the benefit of ED bypass. Those who were selected for ED bypass in the report from Bagai tended to have less complicated STEMI presentations, were likely to have a lower mortality risk, and were therefore less likely to show a benefit of ED bypass after adjusting for risk factors that drive mortality or excluding patients with heart failure/shock or non-system reasons for delay.\(^9\)

A dissociation between changes in components of system delay and in-hospital mortality has also been reported for D2B. Wang et al. examined data from 101 hospitals in the GWTG program between 2005 and 2007. Although D2B times decreased from 101 to 87 minutes, in-hospital mortality was not significantly changed (5.1% versus 4.7%; \(p=0.09\)).\(^1\) There was no correlation between changes in D2B time and composite quality measures. They speculate that a singular focus on one measure such as D2B may have “crowded out” attention to other aspects of hospital care that bear on mortality. Another consideration comes from an NCDR report by Rathore et al. who analyzed the relationship between D2B time and in-hospital mortality in
43,801 patients with STEMI treated with primary PCI. The D2B-mortality relationship is relatively flat between 45 and 105 minutes of D2B time and then rises more sharply as D2B increases progressively above 105 minutes. Thus, shortening of D2B time by 13 minutes from 101 to 87 minutes will have less of an impact than shortening D2B time from a higher baseline.

What are we to do with all this information and what are the next big steps for improving systems of care for STEMI?

1. Focusing on a single component of system delay such as D2B or redefining the “door” by bypassing the ED is useful as a performance measure for PCI-capable centers but is not a sufficient measure for improving an overall system’s performance in caring for STEMI patients. Comprehensive care improvement programs that address all steps between admission and discharge after STEMI are needed to ensure that evidence-based therapies are delivered.

2. Continued focus on expansion and refinement of systems of care for STEMI patients is a high priority and is emphasized in the most recent ACC/AHA STEMI guidelines. It would be highly desirable to see greater coordination among the many disparate EMS systems around the U.S. that care for STEMI patients. Mission: Lifeline is a logical quality improvement platform on to which a much more organized pre-hospital network could be engrafted. This would be facilitated if STEMI and out of hospital cardiac events were mandated reportable events to public health authorities.

3. Ultimately we need to see a reduction in total ischemic time, which involves recognition of STEMI symptoms by patients. Every health care provider needs to make each office visit with a patient who has or is at risk for ischemic heart disease a teachable moment to review and rehearse the appropriate actions to be taken when the symptoms of STEMI appear. The American Heart Association is actively assisting clinicians and patients in this regard through its
educational website “Warning Signs of a Heart Attack”

(http://www.heart.org/HEARTORG/Conditions/HeartAttack/WarningSignsofaHeartAttack/Warning-Signs-of-a-Heart-Attack_UCM_002039_Article.jsp). Even the best organized system will not work effectively if patients delay in recognizing their symptoms and 50% of STEMI patients are not transported by EMS.

Conflict of Interest Disclosures: Dr. Antman was a member of the Advisory Working Group that ultimately led to the development of Mission:Lifeline. He was Chair of the Writing Committee for the ACC/AHA STEMI Guideline published in 2004. He is President-Elect of the American Heart Association for 2013-2014.

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Circulation. published online June 20, 2013;
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

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