

Getting to the Right Place at the Right Time Another Piece of the STEMI Puzzle

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Primary percutaneous coronary intervention (PCI) is the preferred revascularization strategy for patients presenting with ST-segment–elevation myocardial infarction (STEMI).¹ The association between timely performance of primary PCI and reduced mortality has been well established in several observational studies.^{2,3} These and other studies have resulted in a series of performance metrics, including door-to-balloon (D2B) time, first medical contact (FMC)-to-device time, and door-in-door-out time (for patients presenting to non-PCI-capable hospitals), which constitute goals for best medical practice. Current guidelines recommend FMC-to-device time of ≤ 90 minutes for patients presenting to PCI-capable hospitals and ≤ 120 minutes for patients presenting to non-PCI-capable hospitals.¹ Despite substantial efforts during the past 2 decades to develop systems of care for the treatment of STEMI as well as to promote these recommendations, a significant percentage of patients ($>30\%$) do not receive reperfusion therapy within guideline-recommended timeframes.^{4,5}

See Article by Green et al

Several barriers to timely treatment of patients with STEMI exist across the continuum of care. The recognition of symptoms by patients is often the largest delay in revascularization.⁶ In addition, the availability and delivery of emergency medical services (EMS) nationwide is heterogeneous and dependent on local resources. Although use of EMS transport is associated with reductions in ischemic time and treatment delays, previous data have shown that only $\approx 60\%$ of patients with STEMI nationwide use EMS for transport to the hospital.⁷ The recognition of ST-segment elevation by prehospital ECG can be another barrier to timely care and has been the target of programs to improve early identification of patients with STEMI. Such prehospital diagnosis of STEMI can also be challenging because symptoms can at times be vague and nonspecific, and only a minority of patients presenting with chest pain are actually experiencing an STEMI.

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Even if symptoms are quickly recognized by the patient, and the diagnosis is made by emergency medical responders, another challenge to timely care involves access to a PCI-capable hospital. For example, a report in 2011 indicated that only 39% percent of all acute care hospitals in the United States had the capability to perform PCI.⁸ This analysis demonstrated that although the number of PCI-capable hospitals had grown significantly over the prior decade, a significant regional imbalance existed, with more densely populated states generally having a higher ratio of PCI-capable hospitals.⁸

Several systems have been developed to combat these barriers to the treatment of patients with STEMI. Notably, the American Heart Association created the Mission: Lifeline program that is a coordinated system of care that aims to turn EMS and hospitals into teams to use guidelines and best practices to treat patients with acute coronary syndromes as well as other time-sensitive emergencies, such as stroke and cardiac arrest.⁹ This program is designed to use innovative approaches and measures to expedite the delivery of care and improve the quality of care of patients with STEMI. It has been widely adopted and also provides substantial data to allow analysis of such approaches.

The study by Green et al,¹⁰ entitled “Taking the Reins on Systems of Care for ST-Segment–Elevation Myocardial Infarction Patients: A Report From the American Heart Association Mission: Lifeline Program,” reported in this issue of *Circulation: Cardiovascular Interventions*, aims to evaluate one aspect of the implementation of regionalized systems of STEMI care in which EMS are allowed to bypass non-PCI-capable hospitals and take patients directly to PCI-capable hospitals. The authors used data from the National Cardiovascular Data Registry Action Registry and compared 6 states that have bypass policies in place with 6 states that do not have such bypass policies. The matched samples were analyzed using logistic regression models (after adjusting for patient- and state-level characteristics) with the primary outcomes measured being receipt of reperfusion and receipt of timely PCI. This large study of 19287 patients across 379 sites demonstrated that a higher percentage of patients living in states with hospital destination policies received primary PCI within guideline-recommended time from FMC (57.9% versus 47.5%). The authors conclude that adoption of statewide EMS policies which steer patients with STEMI to bypass non-PCI-capable hospitals and to go directly to PCI-capable hospitals is associated with faster receipt of guideline-directed therapy.

The authors are to be congratulated on this important and comprehensive analysis of prehospital EMS transport programs. As they demonstrate, the care and outcomes of patients with STEMI can be improved without increasing the number of PCI-capable hospitals. The results indicate that simply

living in a state that has a statewide prehospital plan for EMS transport is associated with improved treatment times for patients with heart attack. This improvement is certainly statistically significant although the absolute magnitude of the improvement in terms of actual minutes saved from FMC to reperfusion is modest. The mean D2B times for patients living in states with EMS destination policies in place in this study improved by 4 minutes (48 versus 52 minutes) as compared with patients living in states without these policies in place. Although it is difficult to be certain of the clinical significance of these findings, as the authors point out, it would seem that any action that shortens reperfusion time is an important step in the right direction. Interestingly, a recent analysis of the National Cardiovascular Data Registry CathPCI Registry demonstrated that although D2B times have significantly improved, the overall in-hospital mortality of patients with STEMI has remained unchanged.¹¹ These results, which appear counterintuitive, are balanced by a reanalysis of the same data which found that patient-specific D2B times were consistently associated at the individual level with lower in-hospital mortality and 6-month mortality.¹² That analysis suggested that risk-adjusted in-hospital mortality and risk-adjusted 6-month mortality in PCI patients had actually risen during the study time period, offering an explanation for the discrepant findings. These conflicting results speak to the fact that many factors exist that may impact STEMI mortality on the individual and population levels, and it is important to approach as many of them as possible in a comprehensive manner. These results also suggest policy implications in thinking about STEMI treatment at the state level. A statewide system of EMS care for STEMI may well lead to improvement in overall efficiency of care, as indicated by the observation in this study that a greater proportion of patients in states with prehospital destination policies had prehospital ECGs obtained.

What else can be done to help expedite treatment for patients with STEMI? Targeting EMS transport is beneficial, but it represents only one component of care. Timely recognition of symptoms of myocardial infarction is another opportunity for improvement. Women often have atypical presentations of myocardial infarction and are, therefore, more prone to late recognition of symptoms as compared with men.¹³ In this regard, community-based educational programs may hold hope for improving early recognition of STEMI. However, when this concept was evaluated in the large REACT trial (Rapid Early Action for Coronary Treatment) involving extensive community-based education, there was no significant improvement in patient-related delays in seeking medical care.¹⁴ Despite these challenges, continuing public health efforts at education should be encouraged and offers hope for improvement in early STEMI identification.

Prehospital ECG recording and timely ECG transmission is another technology that may shorten the time to reperfusion. Obtaining a prehospital ECG to direct urgency of management of reperfusion therapies has been shown to improve the early diagnosis of STEMI.^{15,16} In a meta-analysis of 4 studies comparing prehospital ECG to no prehospital ECG, there was a 24.7-minute decrease in time to reperfusion therapy in the prehospital ECG group.¹⁷ In a large, registry-based study

of the association of prehospital ECG use with D2B time, an average reduction in D2B time of 16 minutes was observed.¹⁸ The American Heart Association updated the cardiopulmonary resuscitation and emergency cardiovascular care guidelines in 2015 to recommend that a prehospital 12-lead ECG be acquired early for patients with possible coronary syndromes, and prehospital notification should be made for all patients with a recognized STEMI on the prehospital ECG.¹⁹ These guidelines also recommend that computer-assisted ECG interpretation may be used in conjunction with physician (or trained provider) interpretation to recognize STEMI. In areas where a physician or trained provider may not be readily available for ECG interpretation, smart phone technology may provide an easy and efficient solution to having a trained provider rapidly evaluate and interpret the prehospital ECG to direct appropriate patient care.

Streamlining regional systems of care for patients with STEMI is also important. A major challenge in this process is the fact that EMS are fragmented across the United States. This aspect of care was tackled in an initiative of the American Heart Association Mission: Lifeline program, the STEMI Systems Accelerator-1 project. This program involved establishment of leadership teams, protocols, and provider feedback loops for 484 hospital and 1253 EMS agencies in 16 distinct regions across the United States.²⁰ The authors found that there was a significant increase in the proportion of patients in the study that met guideline-directed goals for FMC-to-device time in patients presenting by EMS, as well as for transferred patients.²⁰ Subsequently, the Accelerator-2 project improved on the initial regionalization program with the addition of full-time regional coordinators, as well as ongoing engagement of national faculty within the program. The Accelerator-2 results, published this year, demonstrated not only that regionalization of STEMI care improves reperfusion times but also that this intervention was associated with decreased in-hospital mortality.²¹ These 2 programs are the largest national efforts to streamline regionalized STEMI care and have demonstrated clear, substantial improvements. These findings further support the concept of a national cardiovascular emergency system of care, as previously outlined by Graham et al.²² More work needs to be done in this arena to more broadly implement these types of regionalized programs.

The timely delivery of appropriate care to patients with STEMI is complex and has many unique facets. The present analysis demonstrates that allowing EMS providers to bypass non-PCI-capable hospitals in favor of PCI-capable hospitals can significantly reduce time to appropriate reperfusion therapy. Other aspects of care for these patients offer areas for improvement, including the routine use of prehospital ECG transmission (and early cath laboratory activation), the development of community-based education outreach programs to improve patient symptoms recognition, and the continued development of regionalized systems of care for patients with STEMI to reduce the overall time from EMS activation to reperfusion therapy. Although much work has already been accomplished to expedite the care of these patients, we need to continue to put together all the pieces of this puzzle to provide the best possible heart attack care for our patients.

Disclosures

None.

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