

EDITORIAL COMMENT

Accelerating ST-Segment Elevation Myocardial Infarction Care

Emergency Medical Services Take Center Stage*

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Coronary heart disease, with acute myocardial infarction as its acute manifestation, continues to be the number 1 killer worldwide (1). Reperfusion therapy, especially with primary percutaneous coronary intervention (PCI), can reduce mortality by more than 25%. Earlier reperfusion provides greater benefit, particularly in the early hours of infarction (2).

See page 339

Although it is perfectly clear that optimal reperfusion therapy can save lives, it is equally clear that it has not been applied effectively in the U.S. Important advances have been made in implementing approaches for, and achieving, faster door-to-balloon times at primary PCI centers (3). However, the large proportion of patients who are transferred from a non-PCI center to a PCI center for primary PCI are treated with delays much longer than are acceptable according to all international guidelines, with only 8.6% of such patients being treated from first door to balloon within 90 min as recently as 2006 (4). Moreover, more than 1 in 10 patients who should be getting reperfusion therapy are not getting it all (5). Many patients would get more benefit from rapid fibrinolytic therapy—even in the pre-hospital setting—than from the long delays commonly occurring with transfers from primary PCI (2). Furthermore, there may be very long delays, or no reperfusion at all, for patients with contraindications to fibrinolytic therapy who are remote from PCI centers.

Why is it that we have failed to provide care that meets current standards in so many patients? A major reason is the

lack of systematic integration of the components of care with a true focus on the patient. It is ironic that the U.S. health care system, the most expensive, consuming 15% of our nation's gross domestic product, is among the world's most fragmented, especially when care involves more than 1 hospital. Earliest identification of ST-segment elevation myocardial infarction (STEMI) depends on emergency medical services (EMS) obtaining and interpreting a pre-hospital electrocardiogram (ECG), at least for the 50% of patients who call 9-1-1 (6). This requires substantial technology and training, which is difficult given the fragmented nature of EMS in the United States. Moreover, EMS is grossly underfunded, with the average paramedic earning less than the average sanitation worker (7). Then when the diagnosis is made by EMS, a system is needed that will identify the most appropriate primary PCI hospital, bypass non-PCI hospitals when appropriate, and activate the catheterization laboratory (6). Many have questioned whether this can be done, and if so, if it would improve care. In this issue of *JACC: Cardiovascular Interventions*, Rokos et al. (8) have answered both of these in the affirmative.

The investigators represent 10 networks around the U.S. using common approaches that integrate pre-hospital ECGs, pre-hospital catheterization laboratory activation, and bypass of non-PCI centers. Door-to-balloon times were remarkably good, with 86% of patients achieving door-to-balloon within 90 min, which may be the best performance ever reported in a cohort this size, albeit a highly selected one. In a subset of patients where evaluable, 68% achieved a pre-hospital ECG-to-balloon time of within 90 min, a remarkable achievement.

This is an important demonstration project. It can no longer be argued that it is impossible to establish an integrated EMS and hospital system to provide faster primary PCI. The method of ECG interpretation varied, many using computer interpretation at least as part of their strategy, and some using trained paramedics to interpret ECGs, and 1 transmitted ECGs. Although there is an important opportunity to understand how to improve reliability of interpretation and speed of activation (6), for the time being, this study shows that a variety of approaches can work. Ideally, transmission of ECGs to a cardiologist would allow better interpretation of equivocal ECGs; however, adding the step of transmission to the path of catheterization laboratory activation has the potential to add unnecessary delay for some patients.

Simply showing faster times with pre-hospital activation, however, is not enough. More details are needed. Why is it that only 37% of the data from these leading centers included the ability to calculate first ECG-to-balloon times? This raises 2 issues. First, databases should include a number of standard variables, ideally on a national scale, to be able to determine relevant times necessary for assessing one's own performance, refining methods for improvement,

*Editorials published in *JACC: Cardiovascular Interventions* reflect the views of the authors and do not necessarily represent the views of *JACC: Cardiovascular Interventions* or the American College of Cardiology.

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and analyzing data across systems. These variables may include times of first medical contact, first ECG, and catheterization laboratory activation; false activations; bypass of non-PCI centers; and clinical complications during transport. The ACTION (Acute Coronary Treatment and Intervention Outcomes Network) Registry—Get With The Guidelines is being adapted to help address these needs. Second, another casualty of fragmentation is the reliable sharing and integration of EMS information into the hospital record. It is an embarrassment that we have a health system in the U.S. whereby critical medical information from the pre-hospital phase of care is often not available to hospital providers. As more critical aspects of care for STEMI, stroke, and cardiac arrest are moved into the pre-hospital setting, this has become a major deficiency that needs to be fixed.

A common question regarding early activation of the catheterization laboratory by EMS is how often false activation occurs—and a related question of how often true STEMI is missed. In this study, 24% of patients for whom the laboratory was activated did not have primary PCI. Larson et al. (9) reported that 14% of patients in their Minnesota system had no clear culprit artery at catheterization, and 11% had no elevation in cardiac biomarkers, which were interpreted as acceptable rates. Standard definitions of “false activation” and acceptable rates of false activation are important topics for further study, but they cannot be understood until there is better data collection and tracking.

Another controversial aspect of STEMI systems development is the appropriate role of bypassing non-PCI hospitals to go directly to primary PCI centers. Hospital bypass is becoming more and more standard for conditions that benefit from specialized levels of care, including stroke, STEMI, and cardiac arrest, for which New York City now has a protocol for many patients to be taken only to hospitals providing therapeutic hypothermia (10). Though the concept is accepted as an advance in care for STEMI, there is little agreement on what time of transport is acceptable to warrant bypassing another hospital. Some non-PCI centers may object to the loss of patients that would result from the institution of bypass protocols, although this has not been a major barrier for most systems to date, perhaps because only 1 in 20 chest pain calls is a STEMI.

Even though this study shows that patients identified with a pre-hospital ECG and taken directly to a PCI center can have very fast times with a system in place, it is only 1 piece of the puzzle, and in some ways this is the “low-hanging fruit.” The more challenging patients are those presenting to non-PCI centers where timely transfer for primary PCI can be systematically accomplished, fibrinolytic-ineligible patients presenting to non-PCI centers who usually treat with fibrinolytic therapy, and

patients presenting to busy emergency departments with atypical symptoms (11,12). For direct hospital presenters, even “door-to-balloon” is a misnomer. Hospitals generally record patient registration times, not true emergency department arrival times, and our increasingly overburdened emergency departments may take several (or many) minutes to register patients after arrival. Care for each of these groups can be improved with changes to the system approaches (12). The overall goal of improving STEMI reperfusion care is being addressed on a national scale by Mission: Lifeline (11). Improving resources and integration of EMS, including pre-hospital ECGs, catheterization laboratory activation, and non-PCI hospital bypass, is a major focus of Mission: Lifeline.

The most important lesson of this study is that reperfusion with primary PCI can be provided more rapidly if EMS is placed in its rightful position as the front line for integrated STEMI care. Expansion of what these 10 networks have done on a national scale—refined and coupled with better EMS support, data collection and feedback—will improve care and save lives.

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Key Words: door to balloon ■ electrocardiograph ■ emergency medical services ■ percutaneous coronary intervention ■ ST-segment elevation myocardial infarction.