Time to Treatment in ST-Segment Elevation Myocardial Infarction Identifying Dangerous Delays or Diminishing Returns?
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For nearly 50 years, physicians have recognized the close link between ischemic time and myocardial infarct size in patients presenting with ST-segment elevation myocardial infarction (STEMI). Beginning in the 1970s, a series of animal experiments demonstrated the time-dependent nature of this association when investigators temporarily occluded the coronary arteries of dogs and pigs and established the potential for myocardial salvage with rapid coronary reperfusion. These principles were subsequently translated to humans, first with the advent of thrombolytic therapy and then coronary angioplasty. As these therapies became more prevalent, multiple studies demonstrated improved outcomes for STEMI patients who received prompt reperfusion, laying the foundation for the “time is muscle” mantra.2,3

These early data, in turn, led to the genesis of the concept of “door-to-balloon time” (eg, time from hospital arrival to performance of primary angioplasty), which has become one of the most ubiquitous process measures in cardiology. In 2004, a door-to-balloon time within 90 minutes was included for the first time in the American College of Cardiology/American Heart Association (ACC/AHA) Guidelines for STEMI management, and shortly thereafter became a publicly reported metric tied to financial reimbursement by Medicare.4 A broader family of related measures were soon also introduced to more thoroughly assess systems of care, including the time required to transfer patients initially presenting to facilities that were not able to perform percutaneous coronary intervention (PCI capable) (ie, door-in to door-out time).5 As a result, STEMI treatment times became a central focus of local, regional, and national quality-improvement initiatives, driving substantial changes in care delivery and practice patterns.6 Over the ensuing years, the median door-to-balloon time decreased from 96 minutes to 64 minutes while the median door-in to door-out time decreased from 76 minutes to 62 minutes.7,8 Throughout this time, a strong association between shorter reperfusion times and lower mortality was consistently observed.9

The reduction in door-to-balloon time for STEMI patients is arguably one of the most impactful accomplishments in cardiovascular care quality to date, driven by intensive coordinated efforts among individuals, clinical departments, institutions, and regional systems. It serves as a model example of how the systematic collection of clinical data can identify gaps in quality of care, create accountability, drive local process improvement, and ultimately, improve patient outcomes. Given the long-standing focus on timely reperfusion and quality of STEMI care over the past 2 decades, a new look at how health systems are currently performing on these metrics could have important implications for cardiovascular care delivery and help answer 2 key questions. What are the areas in which STEMI care still has an opportunity for improvement? Is the continued primacy of these metrics warranted?

In this issue of JAMA, Jollis and colleagues10 leverage one of the largest cardiovascular registries in the US to provide a contemporary overview of recent trends in treatment times for STEMI patients and their association with in-hospital mortality.10 The study included 114 871 patients with STEMI at 648 hospitals in the Get With The Guidelines–Coronary Artery Disease (GWTG-CAD) registry between 2018 and 2021. The authors analyzed several relevant process measures stratified by mode and place of presentation. The primary metric for all patients was time from first medical contact to reperfusion, with a goal of treatment within 90 minutes for patients presenting directly to PCI-capable centers and of treatment within 120 minutes for patients requiring transfer from another hospital. In addition, for patients presenting to a PCI-capable center, time to electrocardiogram (≤10 minutes) as well as time to catheterization lab activation (≤20 minutes) were included, and for patients requiring transfer, door-in to door-out time (≤30 minutes) was included.

This study had 2 principal findings. First, a substantial portion of patients is not being treated within national time goals. Most notably, only 17% of patients requiring hospital transfer to a PCI-capable center are being reperfused within the recommended amount of time. Second, risk-adjusted, in-hospital mortality was significantly lower for patients who were treated within target times, compared with those who were not, across all process measures—a finding consistent with prior work.

The authors should be commended for their thoughtful re-evaluation of target treatment times in the management of care for STEMI patients. Their findings of suboptimal compliance with national targets underscore why reassessing quality metrics, in light of changing practice patterns and other secular trends, is critical. At face value, these findings reinforce the mantra that time is muscle and support the authors’ call for a “renewed focus on regional efforts to coordinate and expedite care” for STEMI patients. While the importance of coordinated and expeditious care for this high-risk patient population is undeniable, the specific actions that hospitals can—or should—take to further improve overall STEMI outcomes are less clear.

For example, small and rural hospitals that continue to rely more heavily on thrombolytics and that must frequently
transfer patients to PCI-capable facilities are underrepresented in GWTG-CAD because participation in the registry is voluntary. As such, the population-wide impact of delays in care for patients requiring transfer may, in fact, be underestimated in the study. The best tactics to improve care for this group are likely to be different from those to improve care for patients who present in urban centers or well-resourced facilities. In addition, a large proportion (20%) of patients was deemed by reporting sites to have unavoidable delays to timely reperfusion, including those presenting with cardiac arrest, requiring intubation, and those with difficult vascular access. Such complex cases have been excluded from publicly reported quality measures in the past, reflecting an acknowledgment that some delays may not be related to deficiencies in care. Additionally, moving too quickly to meet target treatment times could paradoxically cause harm by discouraging the thorough evaluation of complex signs and symptoms, promoting the performance of unnecessary procedures or encouraging the use of less safe techniques such as femoral (as opposed to radial) vascular access.

Like many broad quality measures, it is important to recognize the potential for unintended consequences of polices that incentivize a singular aspect of patient care. Ultimately, a targeted approach to STEMI care quality improvement, whereby local clinicians identify barriers in care unique to their own institution or health system and then develop tailored solutions, will be required to advance the care of this diverse patient population.

While Jollis and colleagues provide important insights regarding ongoing gaps in STEMI care, a nuanced interpretation of these findings requires an acknowledgment of the observational nature of this study and all the caveats that accompany those methods. As noted by the authors, the extent to which unmeasured confounding may explain some part of the association between meeting target treatment times and lower mortality, not just in this study but also in the many that have preceded it, remains an open question.

In a pair of longitudinal analyses of the ACC's National Cardiovascular Data Registry between 2005 and 2010, despite significant reductions in average door-to-balloon times, as well as a continued association between reperfusion times and improved mortality in the overall STEMI population during those same years, one possible explanation for these seemingly inconsistent findings relates to changes in the overall STEMI population that offset observed improvements in door-to-balloon time. However, another possibility is that patients with longer door-to-balloon times are inherently different from those with clear diagnoses and treatment pathways in immeasurable ways that go unaccounted for in risk adjustment. While decades of data and clinical experience tell us that, all else being equal, shorter reperfusion times are preferable to longer ones, several uncertainties remain. Would all patients benefit from shorter door-to-balloon times or would more targeted policies that focus on complex cases with the longest door-to-balloon times be more effective? Having clearer answers to these fundamental questions would help clinicians better understand whether door-to-balloon time and other related metrics should remain the broad pressing concern as was once demanded or whether guidelines should now be tailored to meet the specific needs of patients who are most likely to derive benefit.

The widespread efforts to improve the timeliness of reperfusion over the last 20 years has undoubtedly saved many lives. However, as physicians contemplate the optimal path forward in managing the care of STEMI patients, they must recognize the clinical and operational nuance that exists in caring for this diverse population and acknowledge the trade-offs associated with uniform quality metrics. Global reductions in time to treatment for STEMI patients has been one of health care's great successes. As we move forward, it may be time to consider whether efforts to achieve additional improvement in target treatment times will result in substantive benefits or whether we have reached the point of diminishing returns.

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**REFERENCES**


2. Indications for fibrinolytic therapy in suspected acute myocardial infarction: collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients. Lancet. 1994;343(8893):311-322. doi:10.1016/S0140-6736(94)91161-4


