Interplay Between Time of Presentation, Timeliness of Reperfusion, and Outcome After ST-Segment–Elevation Myocardial Infarction

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Disparities in care and outcomes among patients presenting with acute ST-segment–elevation myocardial infarction (STEMI) during off-hours remain a matter of considerable interest because they uncover gaps in the healthcare system and opportunities for improvement.

In the report by Dasari et al., the investigators revisited care processes and outcomes among patients presenting with STEMI during off-hours (weeknights, weekends, and holidays) in contemporary clinical practices. They used the Acute Coronary Treatment and Intervention Outcomes Network registry—Get With the Guidelines database to compare STEMI performance measures during off versus on-hours at 447 US hospitals between 2007 and 2010. The investigators reported similar rates of early aspirin use and attainment of door-to-ECG ≤10 minutes and door-to-needle ≤30 minutes in both groups. However, patients undergoing primary percutaneous coronary intervention (pPCI) during off-hours experienced slower mechanical reperfusion, were less likely to achieve timely door-to-balloon (D2B ≤90 minutes), and had higher risk of adjusted all-cause mortality.

The current report is the latest of several investigations in the field and demonstrates notable improvements in care. Compared with earlier reports, the investigators report salient findings including shorter D2B and door-to-needle times overall and during off-hours and smaller time differential in D2B between off- and on-hours. A remarkable finding in their study is that >97% of patients received pPCI as the reperfusion therapy, which reflects the widespread adoption of this superior reperfusion strategy. This is in contrast to prior reports such as the one from the National Registry for Myocardial Infarction registry (2000–2006) in which the use of pPCI, although progressively increasing over time, accounted for slightly >64% of reperfusion therapies at PCI-capable hospitals. Additional in-hospital periprocedural adverse outcomes (bleeding, stroke, shock, etc) were also comparable among patients undergoing pPCI during off- and on-hours. The latter observation speaks for the high quality of pPCI performed during off-hours and contrasts with earlier reports showing more failed angioplasty procedures during this time period.

However, it is interesting to note that the proportion of patients achieving timely door-to-needle in the current report was much less than that achieving timely D2B. This finding was previously documented and likely reflects the complexity of decision making for pharmacological reperfusion. Realizing that only 39% of all hospitals have interventional cardiology capabilities in the current era, it is noteworthy that establishing systems of care to transfer patients to PCI-capable hospitals and administer timely fibrinolytic therapy remains also of paramount importance. In addition, the study by Dasari et al. assessed limited aspects of STEMI care: only 3 of 13 established clinical performance measures for acute myocardial infarction were examined. By excluding patients who did not receive either pPCI or fibrinolytic therapy from their analyses, the authors missed the opportunity to examine rates of acute reperfusion among eligible patients with STEMI. The magnitude of the excluded population not receiving reperfusion therapy is substantial (n=11,512 patients) and, if included in the analyses, would have constituted 21% of the entire population. Despite this study limitation, the extrapolated rate of reperfusion from their analyses still compares favorably with prior reports, which is another testimonial to the advancement made in STEMI care. The investigators also excluded transferred-in patients from their analyses and missed the opportunity to examine newer measures in this large patient population, such as door-in to door-out and first medical contact-to-device times. Furthermore, the authors’ assertion that their findings showed an improvement in in-hospital mortality compared with prior studies is controversial. The observed mortality differences could just be attributable to differences in the proportions of patients receiving acute reperfusion therapy across the various studies.

Given the association of early reperfusion with myocardial salvage and its marked impact on improving STEMI outcomes, reperfusion therapy has been the focus of quality assessment for >2 decades. In the 1996 American College of Cardiology/American Heart Association (AHA) Guidelines, primary percutaneous transluminal coronary angioplasty was given a class I recommendation as an alternative to thrombolytic therapy only if performed in a timely fashion by skilled individuals and in high-volume centers. In the 1999 update of the American College of Cardiology/AHA Guidelines, balloon inflation within 90±30 minutes of admission was added as a performance standard to the aforementioned class I recommendation. A target D2B within 90 minutes was then
established in the 2004 American College of Cardiology/AHA Guidelines for the management of STEMI.\textsuperscript{12} Reperfusion measures (including D2B) were subsequently included in the initial American College of Cardiology/AHA clinical performance measures set for acute myocardial infarction in 2006.\textsuperscript{6} Nonetheless, despite all the emphasis on implementing timely reperfusion, disparities were still present among different races/ethnicities,\textsuperscript{13} and D2B times remained consistently delayed among the elderly, women, and minorities.\textsuperscript{14,15}

The current study\textsuperscript{1} reconfirms that differences in timely mechanical reperfusion still exist with respect to arrival time. Its findings, however, raise multiple questions: is this difference clinically significant? And does increasing in-house catheterization laboratory personnel at all hospitals during off-hours, as alluded to in the report, represent a sound healthcare strategy?

It is important to note that, in the current study, the adjusted all-cause in-hospital mortality was only borderline significantly higher in the pPCI group during off-hours and that the mortality differences were no longer statistically significant after excluding those with patient-related factors for pPCI delay.\textsuperscript{1} Therefore, it seems that the 16-minute time differential in D2B between off- and on-hours was too small to exert a meaningful clinical impact, as shown previously.\textsuperscript{3} It is thus unlikely that enhancing in-house catheterization staffing during off-hours or having an attending cardiologist always available on site at pPCI centers, as suggested in prior reports,\textsuperscript{16} is cost-effective strategies, especially given the decreasing PCI volume nationwide.\textsuperscript{17} Future studies are needed to determine whether these strategies are clinically important and cost-effective in selective high-volume pPCI centers. One way to examine this is to implement these strategies intermittently during off-hour periods at high-volume pPCI centers and evaluate prospectively differences in D2B times and in short- as well as long-term clinical outcomes with respect to arrival time. This is particularly warranted, given that the majority of patients with acute STEMI present during off-hours (63% of all patients with STEMI in the current study). It is also important to help guide the allocation of healthcare resources to the most worthwhile venues. Addressing prehospital factors, such as patients’ education about symptoms, Emergency Medical Services (EMS) transfer, the use of prehospital ECG, as well as the geographic imbalance in the growth of pPCI centers\textsuperscript{7} are few examples of alternative opportunities that can potentially improve timely reperfusion and outcomes.

Although the current study highlights the contemporary narrowing of care disparities between off- and on-hours, it does not specifically examine the impact of the AHA Mission: Lifeline quality improvement program. It will be interesting in the future to assess whether gaps in care processes (D2B and other measures) and mortality between off- and on-hours decrease with increasing participation in the AHA Mission: lifeline program. To do this, one should examine temporal trends for a longer period of time and also adjust in the multivariable regression analyses for multiple confounders, including patient and hospital characteristics, within site correlation, and duration of participation in the program (given secular trends in improved adherence over time). Unlike the American College of Cardiology Foundation D2B Alliance national campaign, which is a targeted feedback approach focused on a single performance measure, the AHA Mission: Lifeline addresses multiple care processes to achieve timely use of multiple guideline-directed therapies among patients with STEMI.\textsuperscript{17} The current study, in which a 16-minute D2B differential did not translate into significant differences in risk-adjusted mortality (after excluding patients with non-system reasons for delay), is a reminder that there may be a threshold effect in the D2B time beyond which no further clinical effect can be evident. One may thus argue that to exert the largest impact on STEMI outcomes, improvements in D2B times should be accompanied by multifaceted approaches to enhance multiple levels of care concomitantly, as advocated by the AHA Mission: Lifeline. Although awaiting the publication of reports confirming the benefits associated with the participation in the AHA Mission: lifeline quality improvement program, prior studies have already demonstrated that participation in quality improvement registries, such as the Get with the Guidelines - Coronary Artery Disease, was associated with improvements in guideline adherence\textsuperscript{19} and resulted in narrowing of treatment disparities over time.\textsuperscript{20} This is why we should strive to implement the salutary recommendation of the 2013 American College of Cardiology Foundation/AHA guideline for the management of STEMI,\textsuperscript{4} which explicitly states that all communities should create and maintain regional systems of STEMI care which include assessment and continuous quality improvement programs.

**Disclosures**

None.

**References**


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