

Do You Need an In-House 24/7 STEMI Program?

The in-house team approach as part of the next phase in STEMI care.

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It has been well recognized that during the last 20 years, there has been a remarkable evolution in the care of patients with ST-elevation myocardial infarction (STEMI). From the landmark Primary Angioplasty for Myocardial Infarction (PAMI) studies and the ultimate demonstration of the overwhelming superiority of primary percutaneous coronary intervention (PCI) over thrombolytic treatment to more contemporary efforts establishing the pivotal role of adjunctive anticoagulation regimens, stents, and approaches to limit bleeding, patients presenting with STEMI in 2013 have significantly improved outcomes and lower mortality compared to those earlier in the PCI era.^{1,2}

However, much of this impressive progress owes little to devices and adjunctive therapies and is instead a func-

tion of improvements in the timeliness of revascularization and promptness of the acute care administered. In essence, we have experienced two distinct phases of progress in acute care of the STEMI patient during the past 2 decades: the initial PCI development phase, related to determining the best technical and pharmacologic approaches to revascularization, and the door-to-balloon time (D2B) phase, in which progress has been achieved by way of systems analysis and instituting approaches that result in more rapid revascularization (Figure 1).³⁻⁷ This era, which effectively began with the groundbreaking work of Bradley and Krumholz, resulted from an elegant series of studies demonstrating several proven strategies based on system analysis and interdisciplinary

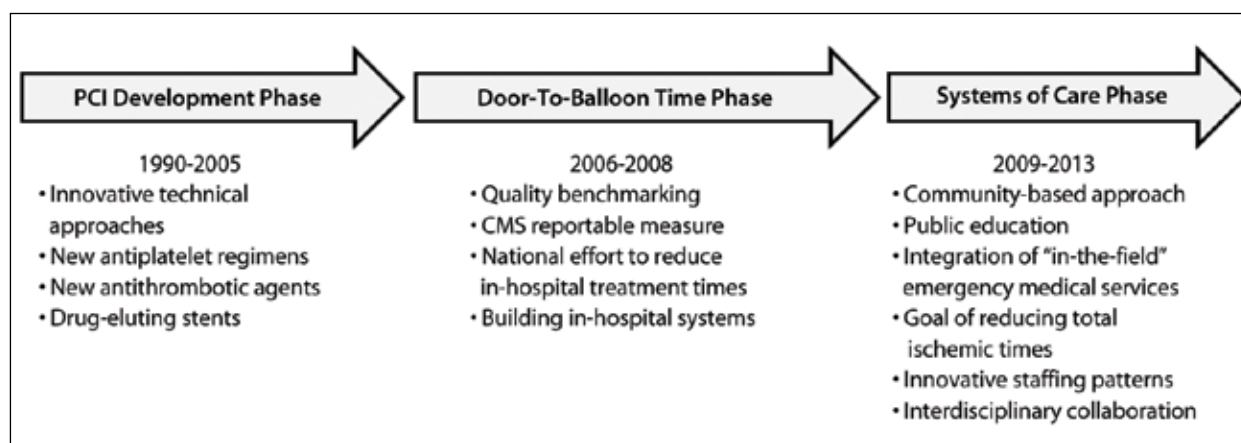


Figure 1. The evolution of STEMI care from 1990–2013.

TABLE 1. SIX PREVIOUSLY ESTABLISHED STRATEGIES TO REDUCE IN-HOSPITAL DOOR-TO-BALLOON TIMES^a

1. Allow emergency department physicians to activate the cardiac catheterization laboratory team
2. Improved communication to activate team, including use of single-page systems and direct line contact with on-call interventional cardiologist
3. Integrate emergency medical services and ECG transmission
4. A < 30-minute interval between activation page and catheterization team arrival
5. Attending cardiologist on site at all times^b
6. Real-time reporting of outcomes to emergency department

^aAdapted from Bradley and Krumholz.⁹

^bNote that strategy no. 5 is the basis of an in-house 24/7 STEMI program.

collaboration. These strategies dramatically reduce D2B times and increase the likelihood that a patient presenting to a hospital with an acute STEMI can achieve revascularization within 90 minutes, the standard established over the last decade (Table 1).^{8,9}

DOOR-TO-BALLOON TIME

The 2006 creation of the ACC D2B Alliance and the decision by the Center for Medicare and Medicaid Services (CMS) to require hospitals to submit D2B data as a core measure with public reporting have led to the widespread adoption of many effective D2B strategies and have been a major driver of recent improvements in D2B time across the United States. Presently, the American Heart Association, the American College of Cardiology, and the Joint Commission on Accreditation of Healthcare Organizations have incorporated this metric as a core hospital quality-of-care indicator. A recent report from Krumholz et al demonstrates the effects of this national effort, with the percentage of CMS-reportable patients achieving revascularization within 90 minutes improving from 44.2% to 91.4%.¹⁰

SYSTEMS OF CARE

Progress in treating patients with STEMI should not be considered complete, however, as we are likely in the early stage of the third evolutionary phase in STEMI care: the systems-of-care phase.¹¹ The systems-of-care phase maintains that the focus of improving STEMI care should shift to consideration of limiting total ischemic time, not simply the achievement of a 90-minute D2B time. As such, the 2009 ACC/AHA updates to the Guidelines for

the Management of Patients with STEMI recommend an “as-soon-as-possible” rather than a specific time benchmark for reperfusion in the setting of STEMI, based on the fact that “any delay in time to reperfusion after arrival at the hospital was associated with a higher adjusted risk of in-hospital mortality in a continuous, nonlinear fashion.”¹² An intended focus of these recommendations has been on improving ischemic time by involving providers and improving systems within the community and outside of the hospital setting. This has included efforts to diagnose STEMI in the field with 12-lead EKG capability, educating the public about using community emergency medical service (EMS) systems more frequently, creating regional STEMI networks, and using wireless and other technologies to alert on-call teams and lower in-hospital and D2B response times. Yet, one of the most frequently overlooked opportunities for significant system-based improvement in ischemic time is the creation of in-house 24/7 STEMI teams where an entire catheterization laboratory team, consisting of a catheterization laboratory nurse, radiation technologist, and attending cardiologist, is present in the hospital 24 hours/day, 7 days per week.

WHY CREATE A 24/7 STEMI TEAM?

The development of a 24/7 STEMI team to perform primary PCI rapidly during both on and off hours is in large measure based on the idea that current procedural systems and approaches used to decrease D2B have little ability to further substantially lower total ischemic time in this patient population, and instead now result in small, incremental D2B improvements. Behind the recent ACC/AHA Guidelines’ support of an “as-soon-as-possible” approach to STEMI treatment is the recognition of the arbitrary nature of a 90-minute reperfusion threshold, which should not be our ultimate system goal. This concept is supported by NCDR (National Cardiovascular Data Registry) data demonstrating a relationship between D2B and in-hospital mortality for D2B < 90 minutes, in which a decrease in D2B from 90 minutes to 60 minutes was associated with an absolute decrease in hospital mortality by 0.8%, and further decreases to < 60 minutes were demonstrated to have an additional absolute 0.5% decrease in mortality.¹³

To date, however, there has been little published data or systematic effort to determine approaches that can consistently and routinely result in D2B times < 60 minutes. Despite this, a recent intriguing report from the Western Denmark Database suggests that mortality related to system delay is independently associated with mortality, with an adjusted HR of 1.1 per 1-hour delay, but D2B delay had an equivalent or greater association with

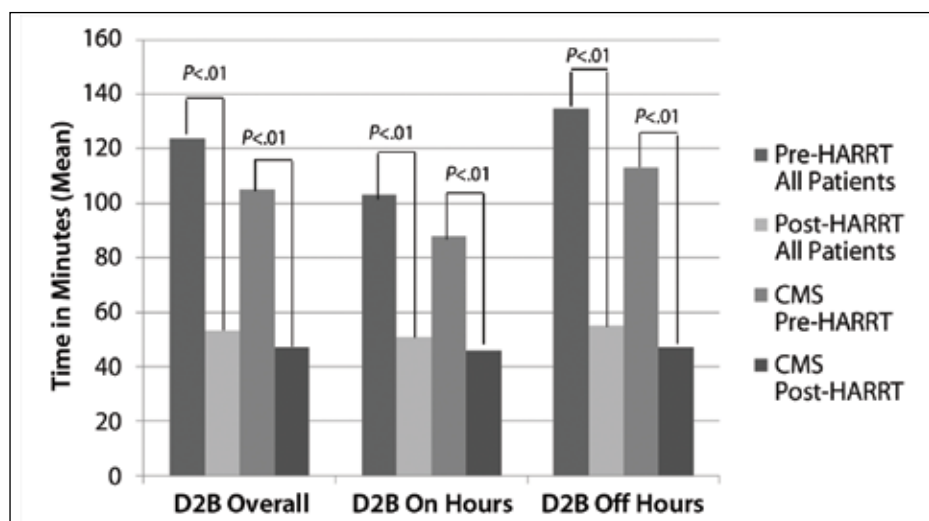


Figure 2. A comparison of D2B times for all subjects treated before and after HARRT (heart attack rapid response team) implementation, with subgroup analysis for off- versus on-hours and core-measure-eligible-only cases. Note that after 24/7 program implementation, there is no significant difference between on- and off-hour presentation for D2B time.

mortality, with an adjusted HR of 1.14 per 1-hour delay.¹² Therefore, efforts to dramatically improve revascularization times once patients arrive at the hospital, such as with an in-house 24/7 system, are likely to have as much, if not more, benefit in regard to patient outcomes as compared to efforts to affect system delays outside the hospital setting.

Although the widely utilized strategies for D2B improvements have resulted in nearly all hospitals being able to routinely reach the 90-minute D2B threshold, a 24/7 STEMI team approach is designed to fundamentally change the paradigm for STEMI reperfusion by moving to a “trauma” model of care for these patients. In fact, although many of the delivery system adaptations for STEMI treatment are based on approaches used for trauma patients, including rapid field triage and activation of a single team, not all established trauma center approaches are widely used. Level I trauma centers operate 24 hours a day, 7 days a week to limit any delays in assembling medical staff and providing treatment, with a requirement of in-hospital physicians capable of delivering specialized care, and have resulted in a 20% to 25% higher likelihood of survival.¹³ Despite the fact that one of the six proven strategies by Bradley and Krumholz is that “an attending cardiologist is always at the hospital,”⁸ the vast majority of hospitals in the United States employ interventional cardiologists and catheterization laboratory staff who are not on site during off hours, delaying the delivery of definitive treatment.

Clearly, the potential benefit of a 24/7 in-house STEMI team will be concentrated on patients who present during off hours (weeknights, weekends, and holidays). Although there are some conflicting data in this regard, Magid and others have shown that patients who present with STEMI during non-working hours represent a particularly high-risk group facing significant time delay to reperfusion therapy.^{14,15} It is in this population that the greatest benefit of an in-house 24/7 STEMI program is expected to be seen, by improving or eliminating

the disparity in ischemic time between a patient who is unlucky enough to present in the middle of the night and needs to wait for the arrival of the on-call team and the patient who presents during daytime hours, in which a short D2B time can be easily accomplished.

EVIDENCE FOR THE EFFECTIVENESS OF A 24/7 STEMI PROGRAM

Because an in-house 24/7 STEMI team approach is a novel strategy incorporated in only a few hospitals in the United States at the present time, there is currently only limited published experience with this approach. The initial report of an in-house 24/7 STEMI program from Allaqaband et al, who compared results from 2004 to 2007 to their institutional historical controls, demonstrated a significant decrease in D2B time from 99 minutes to 55 minutes, with D2B < 90 improving from 40.1% to 88.6%.¹⁶ These data, however, were largely collected prior to widespread D2B system improvement strategies.

In 2009, Loyola University Medical Center moved to create an in-house 24/7 STEMI team approach called the Heart Attack Rapid Response Team (HARRT) to attempt to routinely achieve dramatically low D2B times, with a system goal of < 60-minute D2B for all patients, regardless of presentation time and core measure exclusion criteria. We recently reported the initial 1-year experience with such a program, demonstrating a dramatic 57% reduction in D2B time, equal to a 71-minute decrease.¹⁷ Even with an analysis restricted to only CMS-eligible patients in an effort to exclude outliers and patients

TABLE 2. SUMMARY OF PROGRAM CHARACTERISTICS ASSOCIATED WITH A 24/7 STEMI PROGRAM**Characteristics of STEMI Programs Likely to Benefit From an In-house 24/7 Team**

- Metropolitan or urban location
- Large-volume program
- Small geographic territory where EMS arrival time to hospital is short
- STEMI cases predominantly arrive directly at treating hospital rather than in transfer
- STEMI patients/population frequently present at treating hospital without EMS assistance (walk-in population)

with unavoidable delays to PCI, there was a 44% reduction in D2B time, representing an absolute 58-minute decrease in time to revascularization of the culprit vessel. Furthermore, this pilot program demonstrates the feasibility of such an approach to routinely achieving extremely short D2B times, with 100% of patients meeting the current national goal of D2B time < 90 minutes and more than 80% of patients achieving a D2B time of < 60 minutes. In addition, the implementation of this program has resulted in significant benefits with regard to resource utilization and a decrease in subsequent cardiovascular hospitalizations (Figure 2).¹⁷

Importantly, the initiation of the HARRT program resulted in complete elimination of the discrepancy between on- and off-hour D2B time (54 vs 55 minutes), with the comparable core measure eligible group at 46 versus 47 minutes (on- vs off-hour). With regard to benchmark D2B thresholds, the initiation of the in-house HARRT program improved the percentage of patients reaching the 90-minute D2B goal from 58.7% to 100%, and the programmatic 60-minute D2B goal improved from 19% to 84%.

As noted previously, there is a limited amount of data related to the effectiveness of such programs, but the Loyola University Medical Center experience has been dramatic. Further analyses are planned, including determining the role of such a program on the treatment of non-STEMI patients in whom earlier revascularization is routinely performed under this program and where previous work has suggested that it may improve outcomes in the higher-risk subgroups within this population.^{18,19}

Additionally, the effect of an in-house STEMI program on special populations, including cardiac arrest patients and those who develop STEMI after hospital arrival (where very rapid revascularization can occur with such a program during off hours), are anecdotally promising and subject to planned upcoming analyses.

WHO SHOULD CONSIDER AN IN-HOUSE 24/7 STEMI APPROACH AND HOW TO ESTABLISH IT

During the last decade, several in-house 24/7 STEMI programs have been established at hospitals in the

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United States, including St Luke's Medical Center (Milwaukee, Wisconsin), Detroit Medical Center (Detroit, Michigan), and Loyola University Medical Center (Chicago, Illinois). The decision to enact this model of STEMI care has been made individually at each hospital, but in each case involves a hospital's commitment to provide the best care possible for STEMI patients by decreasing D2B time as much as possible to limit ischemic times and, as a result, improve outcomes.

It is not simply a coincidence that all of these programs are large-volume interventional programs and exist in major metropolitan areas where a large number and proportion of STEMI cases present directly rather than arrive via transfer from non-PCI facilities. By extension, it is logical to assume that the benefits of such a program would be greater at facilities where patients more commonly self-present, rather than activate the EMS system, to arrive at the hospital. In these situations, the benefit of having an in-house 24/7 STEMI team during off hours to respond within minutes to a first EKG performed within the emergency room setting without pre-hospital EMS activation or warning would be expected to save 30 to 45 minutes for each patient.

This type of presentation, while perhaps the exception at some hospitals, is in fact typical in our experience, where during the initial first-year in-house 24/7 STEMI team experience, 65% of STEMI patients presented directly to our emergency room without contacting EMS. Other recent data also suggest that approximately

75% of STEMI patients arrive at the hospital via self-transport or transport by family.^{11,15,20} In such a situation, lack of EMS involvement and prehospital EKGs eliminate the ability to preactivate the catheterization laboratory team.

Similarly, the benefits of an in-house 24/7 program would also be expected to be more pronounced in urban or metropolitan hospital systems where the STEMI volume is drawn from a compact geographical distribution. In such a setting, even those patients in whom prehospital EMS activation occurs would be expected to arrive at the receiving facility long before the on-call team during off hours (Table 2). In contrast, it is unlikely that the magnitude of improvement in D2B and total ischemic time seen by in-house 24/7 STEMI programs would be replicated in many other types of programs. Specifically, hospitals located rurally, with small STEMI populations, or where a majority of STEMI patients arrive via transfer would be unlikely to experience the D2B benefits demonstrated in our experience at Loyola University Medical Center.

In addition, there are a number of unresolved issues related to these novel in-house STEMI programs regarding their practicality and cost of widespread implementation. Establishment of a 24-hour, in-house program of the type reported here and by Allaqaband¹⁶ is expensive, with an incremental cost that would be unaffordable for many hospitals, although in our experience, the incremental staff overtime costs are mitigated by creative staffing patterns and the use of these teams to cover other interventional specialties' off-hour cases. Physician and staff acceptance of such a program, as well as "burnout," are also considerations; however, with proper staffing ratios, we have found widespread support for this approach. It is worth considering, however, that incorporating an in-house 24/7 STEMI team approach in a collaborative regional model may benefit some smaller hospitals, where the loss of a very small number of off-hour STEMI cases could be balanced by the reduction in catheterization laboratory overtime and overhead during off hours.

CONCLUSION

The development of an in-house 24/7 STEMI program approach for improving rapid revascularization of STEMI patients is capable of achieving routine D2B times far below the national average and dramatically surpassing accepted standards for this important benchmark. The value of this approach and its future acceptance and incorporation can only be determined by larger studies and analyses across regional systems where outcome, cost, and cost-benefit analyses can be performed. ■

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