

Activation of the Cardiac Catheterization Lab for STEMI Patients

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Our institution lowered door-to-balloon times by empowering EMS to activate the cardiology laboratory prior to arrival at the hospital.

Coronary heart disease remains the leading cause of death of US adults aged 35 years and older due to the downstream consequences of arterial occlusion and ensuing myocardial ischemia.^{1,2} Among patients with coronary heart disease, 30% to 33% will present with ST-segment elevation myocardial infarction (STEMI).³⁻⁵

For STEMI patients, access to a facility with percutaneous coronary intervention (PCI) capabilities is critical. Door-to-balloon (D2B) time is used as a performance measure to assess the quality of care that STEMI patients are receiving. Data show that decreasing D2B times can improve outcomes of STEMI patients, with lower D2B time associated with lower mortality



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rates.⁵ To obtain and maintain the lowest D2B times possible, health care systems must adopt best practice models to continually improve patient outcomes.

The current best practice for patients with an acute STEMI involves bypassing non-PCI centers and transporting patients directly to PCI-enabled centers—as long as the patient's total emergency medical services (EMS) contact-to-balloon time remains low. In a study by Le May et al,⁶ patients directly transported to a PCI-enabled center had a mortality rate of 5% within 180 days compared to 11.5% for those who were first seen at a center without PCI capabilities.

Longer EMS transport time to PCI centers, however, requires earlier cardiac catheterization laboratory (CCL) activation to prevent delays in care. Emergency physicians (EPs) must work with local EMS, PCI and non-PCI centers, and interventional cardiologists to establish protocols

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to expedite STEMI patient care. Previous studies, however, have shown that paramedics are able to diagnose STEMI patients during transport and can activate the catheterization team from the field, with beneficial patient outcomes.⁷⁻¹¹ Prior to July 2011, all patients with a suspected MI who were transported to our institution via EMS were not diagnosed with STEMI until evaluation by an EP. Because the CCL had no in-house staff after hours, the interventional cardiology team required 30 minutes to respond and prepare. In 2011, our EMS, in conjunction with county hospitals, EPs, and cardiologists, implemented an initiative that empowered paramedics to activate STEMI alerts from the field.

This provided advanced notification to the interventional cardiology laboratory team to initiate preparation for patients in need of immediate PCI.

Since the best practice for STEMI patients involves early diagnosis and immediate activation of the cardiac catheterization team, we sought to improve the outcomes for STEMI patients by utilizing prehospital care initiatives to lower D2B times. Other health care systems have utilized EPs to receive the transmitted electrocardiogram (ECG) and to initiate CCL team activation. We found that having both the EP and cardiologist review the ECG delayed the activation process when compared to direct activation by EMS. Our initiatives to improve time to CCL activation included the following:

- (1) Training and enabling paramedics to diagnose a STEMI on the ECG;
- (2) Bypassing non-PCI centers for PCI centers during STEMI patient transport;
- (3) Allowing paramedics to activate the CCL at our institution prior to transmitting an ECG and prior to patient arrival at the hospital; and
- (4) Bypassing the ED to go directly to the CCL when the CCL was ready to receive the patient. (When the CCL was not ready, patients were transported to the ED. After reviewing the transmitted ECG, the EPs could cancel the STEMI alert if indicated.)

By empowering EMS to diagnose and activate the CCL, we also measured the rate of unnecessary activations, which was defined as patients who did not present with chest pain and an ECG showing ≥ 1 mm ST segment elevation in two contiguous limb leads, or ≥ 2 mm ST segment elevation in two contiguous precordial leads.

Causes of unnecessary activation by EMS included left ventricular hypertrophy, left bundle branch block, early repolarization, non-specific ST segment changes, pericarditis, and ventricular paced rhythms. We recorded and analyzed D2B times and the unnecessary activation rates, and continuously used these data for quality improve-

ment. Our goal was to decrease D2B times and unnecessary activation rates, while maintaining these improvements over time.

Our ED has 93,000 patient visits annually, and our hospital serves as the only PCI center within a county encompassing 1,255 square miles. Our hospital EMS used 12 Lifepak monitors to help interpret patients' ECG. To study the impact of our initiative, data were collected each year from 2011 to 2015. The 2011 data were recorded before EMS began to activate the CCL and served as the baseline for the D2B times. These data were then compared to postintervention D2B data from 2012 to 2015.

In addition to collecting unnecessary activation rates by EMS paramedics from 2012 to 2015, we continuously used the unnecessary activation data to identify why these activations were occurring and to devise a strategy to improve rates. Emergency physicians have a leadership role regarding EMS training and oversight, ongoing paramedic education, and the quality improvement process.

A Reduction in D2B Time

Our baseline D2B time prior to the intervention was 52.5 minutes. After our intervention, average D2B times for 2012, 2013, 2014, and 2015 were 38.2, 33.5, 39, and 37.25 minutes, respectively. The institution's baseline rate of unnecessary activation prior to intervention in 2011 was 19.1%. After intervention, the EMS unnecessary activation rates for 2012, 2013, 2014, and 2015 were 30%, 18%, 15%, and 19% respectively, averaging 20.5% over 4 years, or 17.3% for 2013 through 2015.

Emergency medical services averaged approximately 164 STEMI activations each year. We decreased D2B times for patients by over 15 minutes from 2011 compared to 2012 through 2015. These results were sustained, with attention to metrics, over four years. Furthermore, the proportion of STEMI patients receiving immediate PCI within the recommended 90 minutes was 100% of

patients in 2014 and 2015, reflecting consistent improvement over 2012 and 2013.

We also demonstrated an overall reduction in the unnecessary CCL activation rate by EMS over the time of our intervention. Our analysis of unnecessary activation causes and EMS education led to improvement in the unnecessary activation rate



from 2012-2015, and these rates have been sustained over time. The rate of unnecessary activation by EMS in 2012 to 2015 was 20.5%.

Conclusion

Lower D2B time for STEMI patients is associated with lower mortality following PCI for patients with acute MI, fewer complications, and shorter length of stay in the hospital. We successfully lowered D2B time after empowering EMS to activate our interventional cardiology laboratory prior to arrival at the hospital for patients with acute STEMI, coupled with the ability to bypass the ED for patients with acute STEMI presentations. With rigorous attention to metrics and ongoing aggressive medic education, we were able to achieve consistent, sustained D2B times under 40 minutes over the course of four consecutive years. We present our experience as a potential model of a multifaceted intervention for other systems to consider replicating.

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