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EMERGENCY MEDICAL SERVICES AS A STRATEGY FOR IMPROVING ST-ELEVATION MYOCARDIAL INFARCTION SYSTEM TREATMENT TIMES

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☐ **Abstract—Background: Reducing delays in time to treatment is a key goal of ST-elevation myocardial infarction (STEMI) emergency care. Emergency medical services (EMS) are a critical component of the STEMI chain of survival. Study Objective: We sought to assess the impact of the careful integration of EMS as a strategy for improving systemic treatment times for STEMI. Methods: We conducted a study of all 747 nontransfer STEMI patients who underwent primary percutaneous coronary intervention (PCI) in Dallas County, Texas from October 1, 2010 through December 31, 2011. EMS leaders from 24 agencies and 15 major PCI receiving hospitals collected and shared common, de-identified patient data. We used 15 months of data to develop a generalized linear regression to assess the impact of EMS on two treatment metrics—hospital door to balloon (D2B) time, and symptom onset to arterial reperfusion (SOAR) time, a new metric we developed to assess total treatment times. Results: We found statistically significant reductions in median D2B (11.1-min reduction) and SOAR (63.5-min reduction) treatment times when EMS transported patients to the receiving facility, compared to self-transport. In addition, when trained EMS paramedics field-activated the cardiac catheterization laboratory using predefined specified protocols, D2B times were reduced by 38% (43 min) after controlling for confounding variables, and field activation was associated with a 21.9% reduction (73 min) in the mean SOAR time (both with $p < 0.001$). Conclusion: Active EMS engagement in STEMI treatment was associated with significantly lower D2B and total coronary reperfusion times.**

☐ **Keywords—myocardial infarction; angioplasty; EMS; emergency medical services; STEMI; ST-elevation myocardial infarction**

INTRODUCTION

Regionalization and development of systems of care for ST-elevation myocardial infarction (STEMI) have been shown to improve both responsiveness of the system and overall quality of patient care (1–4). Rapid reperfusion, most commonly through percutaneous coronary intervention (PCI), must be provided for in the coordination of care in order for communities to control the various time intervals required for patients passing through the transitions of care: prehospital emergency medical services (EMS); emergency department (ED) triage; and transfer to the cardiac catheterization laboratory (CCL). Strategies for reducing hospital door to balloon (D2B) times, measured as the difference in

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minutes between hospital arrival and first balloon inflation, have been the focus of significant research (5,6). Other researchers have pointed out a need to quantify and evaluate beyond only hospital-controlled response times, measuring symptom onset through balloon inflation (5,7). Other studies have shown that prehospital activation of the CCL significantly improves time to treatment by nearly 18 min for STEMI patients (8). Few studies have measured both hospital delays and total system delays in a comprehensive study with large sample size (7).

The current American Heart Association/American College of Cardiology (AHA/ACC) guidelines for STEMI care recommend D2B times of < 90 min from first medical contact (EMS or hospital door arrival) to arterial reperfusion (9). Delays in coronary reperfusion are associated with increased probability of mortality, so there is a need to continuously identify new strategies to reduce systemic treatment delays (10–12). The role of EMS has been described as an important component of rapid STEMI treatment, culminating in the development of a position statement recommending implementation and integration of prehospital electrocardiograms (ECGs) for early recognition and treatment of patients with symptoms indicative of acute coronary syndromes (ACS) (13). Previous studies have found a 10–20-min reduction in D2B times when EMS was activated for a patient suffering from ACS (14). Other studies have found that when EMS is actively involved in a comprehensive, coordinated system providing care for ACS, the proportion of patients meeting the < 90-min D2B criteria increased significantly (15–17). However, most studies are limited to survey results and not actual provider data, and no studies have evaluated the impact of EMS activation on total system treatment times.

Total system treatment delays occur with the complex transition of care as patients are initially diagnosed and transported by EMS, then received in the ED while awaiting initial evaluation and treatment, and then while interventional cardiology and CCL staff are notified. There are also the complexities of hospital registration while gaining legal consents for care. Transitioning through all of these steps requires a complex, coordinated system, involving multiple "handoffs" that can cause increases in the time intervals of the various systems of care. Early engagement of qualified EMS personnel to quickly recognize and identify STEMI using electrocardiography has been described as a strategy to help reduce D2B times (18).

The present study seeks to build on the theoretical framework offered by Bradley et al. and Nallamothu et al., both of whom describe the need for further study of metrics, measuring total system treatment delays from the start of symptom onset through balloon inflation, looking beyond the hospital for strategies to improve response times (5,19). We hypothesized that, when controlling for other clinical confounders, those patients transported by EMS would have systemically lower treatment times than those using self-transport. In Dallas, we relied on detailed, de-identified patient data from multiple data sources (both hospital and EMS), including indicators for CCL field activation by EMS, and temporal details of EMS runs and transport. Our specific research question explores whether EMS engagement in a STEMI system of care would improve overall response times, through two variables involving CCL activation by EMS and EMS transport, compared to self-transport. We used the Dallas County experience to test whether coordinated EMS engagement would help to reduce overall coronary reperfusion times. Further, we tested whether EMS engagement would reduce overall time to definitive care, including the provision of PCI, through our measure of symptom onset to arterial reperfusion (SOAR).

MATERIALS AND METHODS

Study Setting

In 2010, the AHA secured a $3.5 million grant from the W. W. Caruth, Jr. Foundation of the Communities Foundation of Texas to develop a regionally integrated system of care for patients suffering from ACS in Dallas County, Texas. The project planning and implementation involved a 2.5-year period to organize a STEMI system supported by all PCI hospitals and EMS agencies. The region represents 2.4 million people, 908 square miles, and is the ninth most populous county in the United States. The County has a higher rate of cardiovascular disease than the national mean, with a 3.4% acute myocardial infarction prevalence rate and a mortality rate of 73.1 per 100,000 capita. There are a total of 45 community and teaching hospitals in the County operating 7200 beds, 15 of which have primary PCI capabilities. Operating within the county, there are over 4200 employed certified paramedics and emergency medical technicians, and an estimated 82 interventional cardiologists. Dallas County is primarily urban and suburban, and over 90% of the population is within 15 miles of the city center. The effect of this close proximity is fairly rapid EMS response and transport times for patients suffering from ACS, largely without the use of air transport. PCI facilities are well dispersed geospatially, though less concentrated in the southern regions of the municipality. Figure 1 presents the locations of the PCI facilities and EMS agencies in a 15-mile radius.

In the Dallas County Caruth project, EMS was central to improving coordination and improving system response times from the beginning. Agency leaders