ORIGINAL RESEARCH

Reduction in STEMI Transfer Times Utilizing a Municipal "911" Ambulance Service

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Conflicts of interests: The authors have no disclosures or conflicts of interest to report.

Keywords: cardiac catheterization; Emergency Medical Services; myocardial infarction; prehospital care

Abbreviations:
ALS: Advanced Life Support
DIDO: door-in to door-out
DTB: door-to-balloon
ECG: electrocardiogram
EMS: Emergency Medical Services
PCI: percutaneous coronary intervention
PCR: patient care report
STEMI: ST-segment elevation myocardial infarction
UHU: unit-hour-utilization

Received: June 14, 2013
Revised: August 9, 2013
Accepted: September 15, 2013

Online publication: January 22, 2014

doi:10.1017/S1049023X14000016

Abstract

Introduction: The time interval from diagnosis to reperfusion therapy for patients experiencing ST-segment elevation myocardial infarction (STEMI) has a significant impact on morbidity and mortality.

Hypothesis: It is hypothesized that the time required for interfacility patient transfers from a community hospital to a regional percutaneous coronary intervention (PCI) center using an Advanced Life Support (ALS) transfer ambulance service is no different than utilizing the "911" ALS ambulance.

Methods: Quality assurance data collected by a tertiary care center cardiac catheterization program were reviewed retrospectively. Data were collected on all patients with STEMI requiring interfacility transfer from a local community hospital to the tertiary care center's PCI suite, approximately 16 miles away by ground, 12 miles by air. In 2009, transfers of patients with STEMI were redirected to the municipal ALS ambulance service, instead of the hospital's contracted ALS transfer service. Data were collected from January 2007 through May 2013. Temporal data were compared between transports initiated through the contracted ALS ambulance service and the municipal ALS service. Data points included time of initial transport request and time of ambulance arrival to the sending facility and the receiving PCI suite.

Results: During the 4-year study period, 63 patients diagnosed with STEMI and transferred to the receiving hospital's PCI suite were included in this study. Mean times from the transport request to arrival of the ambulance at the sending hospital's emergency department were six minutes (95% CI, 4-7 minutes) via municipal ALS and 13 minutes (95% CI, 9-16 minutes) for the ALS transfer service. The mean times from the ground transport request to arrival at the receiving hospital's PCI suite when utilizing the municipal ALS ambulance and hospital contracted ALS ambulance services were 48 minutes (95% CI, 33-64 minutes) and 56 minutes (95% CI 52-59 minutes), respectively. This eight-minute period represented a 14% ($P = .001$) reduction in the mean transfer time to the PCI suite for patients transported via the municipal ALS ambulance.

Conclusion: In the appropriate setting, the use of the municipal "911" ALS ambulance service for the interfacility transport of patients with STEMI appears advantageous in reducing door-to-catheterization times.

Tennyson JC, Quale MR. Reduction in STEMI transfer times utilizing a municipal "911" ambulance service. ***Prehosp Disaster Med*****. 2014;29(1):50-53.**

Introduction

Percutaneous Coronary Intervention (PCI) is the established optimal management for the majority of patients presenting to hospitals with acute ST-segment elevation myocardial infarction (STEMI).[1-3] Timely implementation of PCI therapy reduces in-hospital and overall mortality.[2,3] Furthermore, shorter times to inflation of the PCI balloon have shown a direct effect on mortality.[2-7]

Prehospital protocols based on published data have been developed to transport patients with STEMIs directly to PCI-capable centers and/or accelerate their transfer from emergency departments lacking that capability.[8-15] Nevertheless, many patients present directly to non-PCI hospitals without utilizing Emergency Medical Services (EMS). These patients benefit from transfer for primary PCI if the duration from presentation to inflation of the PCI balloon or transfer door-to-balloon (DTB) time can be kept under 120 minutes.[1,2,16-18] To maintain the goal of 120 minutes, the various sources of delay in that transfer process have been studied and time goals for arrival to transfer (eg, door-in to door-out (DIDO)) of <30 minutes) have been established.[19-22] Awaiting arrival of the transferring ambulance represents the most common delay.[22]

In December 2008, a community hospital affiliated with a nearby tertiary care hospital's PCI center changed its procedure for the transfer of STEMI patients who present to its emergency department. Prior practice utilized a contracted local Advanced Life Support (ALS) transfer service or hospital-based helicopter EMS service. With the implementation of the new policy, the local 911 service was called, and the municipal ALS ambulance was dispatched to the hospital to complete the transfer. The quality assurance data maintained by the catheterization laboratory were reviewed to determine if the policy change provided any benefit in DTB times.

Methods

The Department of Emergency Medicine and the Division of Cardiovascular Medicine at the tertiary care center maintain detailed data on times associated with all STEMI patients, including those transferred from other facilities. These data, which include all times associated with the process of transfer, were reviewed for the 23 months before and 52 months after the policy change. This is a retrospective database analysis of those data. The institutional review board approved this project granting a waiver of full review.

In most research into aspects of care of the STEMI patient, the DTB time is the most frequently studied chronologic metric. In contrast, this investigation focused on time associated with each mode of transport from the referring hospital. Only transfers from the outside hospital's emergency department that went directly to the PCI suite were examined. To eliminate the potential confounders of delay in diagnosis, delays to vascular access or diagnostic results (which directed the therapy toward non interventional management) times before the call for an ambulance and after arrival to the catheterization laboratory were not examined.

The data were entered into a spreadsheet (Microsoft Excel, version 14.0.6129.5000, Microsoft Corporation, Redmond, Washington USA) and statistical metrics were derived via Excel's statistical package. The time intervals between call for an ambulance and ambulance arrival at the sending facility were examined and mean values determined. Time intervals from departure from the sending facility to the arrival in the catheterization laboratory were also examined. Finally, the total time from call for an ambulance to the patient's arrival in the catheterization laboratory was examined. The groups were compared using two-tailed *t* tests.

The data were collected as part of the ongoing quality assurance process by the Interventional Cardiology Service. The times used were documented meticulously by the catheterization laboratory personnel as well as the communication center, which handled the interfacility transfers. Additional times were abstracted from printed electrocardiograms (ECGs), from the ambulance patient care reports (PCRs), and from the sending hospital's emergency department medical record. The transport times were compared to a predicted travel time between the facilities, as predicted by an online mapping solution (Google Maps, Google, Inc, 1600 Amphitheatre Parkway, Mountain View, California USA). The predicted travel time was compared to the 95% confidence intervals of the analyzed means. Times that were clearly erroneous, such as a transport time of 148 minutes, or that fell greater than two standard deviations outside the mean, were discarded as inaccurate, reflecting inaccurately collected data.

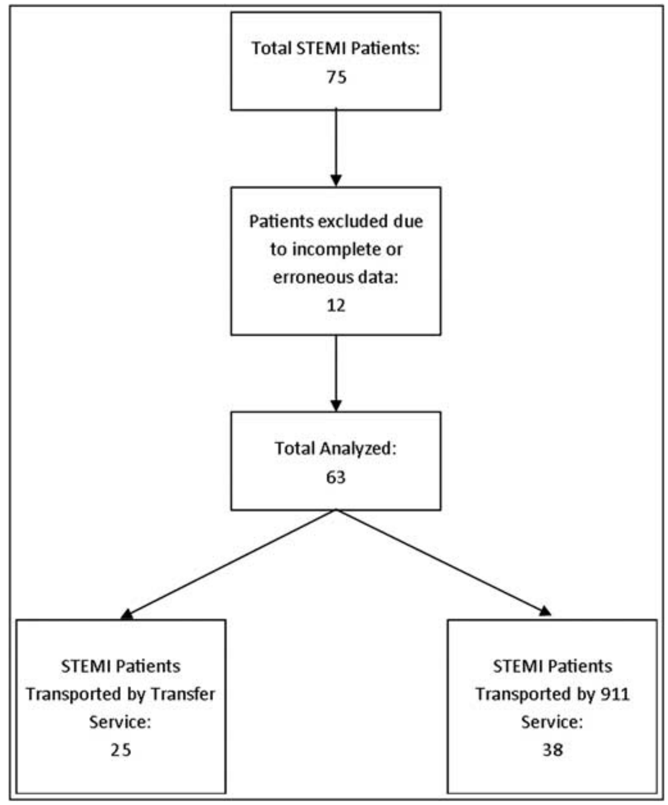

Figure 1. Enrollment Flow Chart Abbreviation: STEMI, ST-segment elevation myocardial infarction.

Results

Data were collected from January 1, 2007 through March 9, 2013. The policy change took place in December 2008, providing 23 months before and 52 months after the change for review. During this time there were a total of 75 patients with STEMI who presented to the community hospital's emergency department. A total of 12 patient records were excluded due to incomplete or erroneous data. Of the remaining 63 records analyzed, 25 patients presented before the policy change and 38 patients presented after the policy change (Figure 1).

The mean time from the call for an ambulance until the ambulance's arrival at the sending emergency department was 13 minutes (95% CI, 9-16 minutes) using the transfer ALS service and was six minutes (95%, CI 4-7 minutes) utilizing the municipal 911 provider (Figure 2). This represents a seven minute (54%) absolute reduction in response time ($P < .001$). The mean time from departure from the sending facility to arrival at the cardiac catheterization laboratory utilizing the transfer service was found to be 24 minutes (95% CI, 22-27 minutes) and utilizing the 911 provider was 30 minutes (95% CI, 21-40 minutes), which represented a 25% increase in transport time ($P < .001$) (Figure 3). When compared with a predicted travel time, it was found that the predicted value (23 minutes) fell within the 95% confidence intervals for both calculated means. Finally, the mean time from the initial call for an ambulance to the patient's arrival in the cardiac catheterization laboratory was

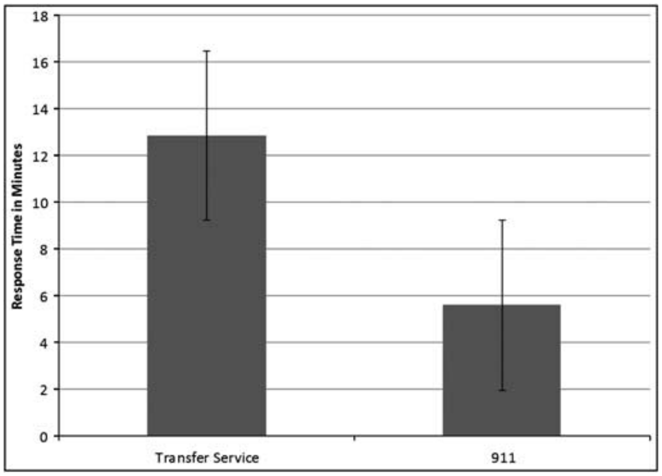

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Figure 2. Mean Time from Call for Transfer to Ambulance Arrival at Sending Hospital

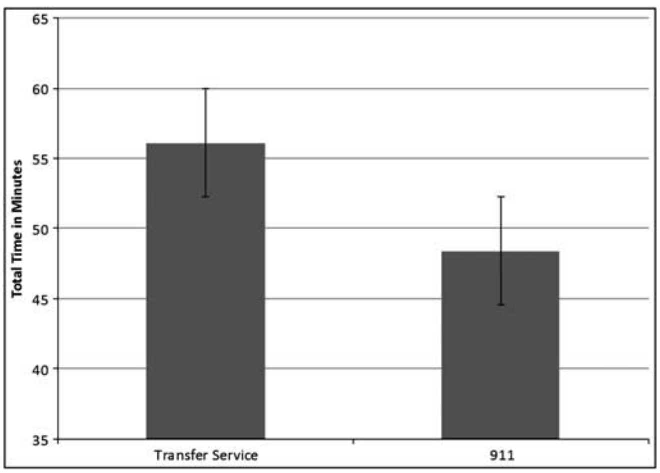

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Figure 3. Mean Time from Call for Transfer to Catheterization Laboratory Arrival

56 minutes (95% CI, 52-59 minutes) with a transfer service and 48 minutes (95% CI, 33-64 minutes) utilizing the 911 provider. This is an eight minute (14%) reduction in total transfer time ($P = .001$).

Discussion

Utilization of the municipal 911 ambulance can reduce the total transfer time for STEMI patients from outlying community hospitals to tertiary care centers with PCI capabilities. While national standards center on DTB times, the overall transport time represents a fixed portion of this process for transferred STEMI patients. The reduction of this time may be viewed as a proxy for reduction of the total time in this process. Baruch and colleagues showed that using the municipal service is safe in a small series in Los Angeles County (California USA).[14] The largest reduction in time in their series was in time from first ECG to ambulance arrival.[14] The utilization of this method must be predicated on the municipal EMS provider having ALS capability.

The system studied operates two paramedic-level ambulances, each staffed with two Massachusetts (USA)-certified paramedics 24 hours per day. The system uses a static positioning model with available ambulances based at the central shared station 1.5 miles from the hospital. The call volume is approximately 11.3 responses per day for the system with 8.5 transports per 24 hour period or 5.6 calls and 4.3 transports per ambulance per day.

The reduction in the response time in utilizing the municipal service accounted for only half of the total time reduction from the call for an ambulance to arrival of the patient at the PCI suite. It is hypothesized by the investigators that the utilization of the municipal ambulance also carried with it an inherent sense of emergency. For the majority of transports included within this data set, the transfer ambulances and the 911 municipal ambulances were provided by the same private company. The same paramedics work on both the ALS transfer and ALS municipal service ambulances. These results suggest that being called for this transport while working the 911 ambulance induces a sense of urgency that might have been absent if the transfer were "routine." This data set was collected over a 6-year period. Employment turnover at private ambulance services, such as the service involved occurs at a rate precluding a reasonable analysis of employee attitudes toward the urgency of the call before and after the policy change.

The increase of 25% in the transport time is not clearly explainable. The time change represented an absolute difference of six minutes. It was initially thought this may represent the influence of the aeromedical transports in the pre intervention period; however, the mean did not change when these were removed for a separate analysis. The 95% confidence interval for the longer, 30-minute mean transport time included the value of the shorter, 24-minute time. This suggests the possibility that with a larger data set, the numbers may converge.

Limitations

There are several limitations to this study. First, the data were collected on a continuous basis from quality assurance data maintained by the cardiac catheterization service. The data obtained dated from the beginning of data collection by the service in January 2007 and concluded in March 2013. Because the sample size was determined by the number of cases available within the sampled period, the number of cases in each arm was unequal. It is possible that this affected the significance of the findings.

Second, the generalizability of this study has limitations. This study was conducted at a small community hospital which was relatively closely positioned to its referral center. It was conducted in a system where the local medical director believed there was adequate coverage for the 911 call volume, such that utilizing the municipal ALS service for transport would not unduly stress the emergency response system. The system studied operates two paramedic-level ambulances, each staffed with two Massachusetts-certified paramedics 24 hours per day. The ambulances are both stationed at a central station, 1.5 miles from the hospital. The call volume is approximately 11.3 responses per day for the system with 8.5 transports per 24 hour period. Assuming approximately one hour of utilization per call, this yields an estimated unit-hour-utilization (UHU) of 0.18, safely allowing for the increased volume of infrequent (75 calls over 74 months or approximately one call per month) STEMI transfers. The practicability of this method of transporting STEMI patients from the community hospital must balance local municipal call volume with available resources and geography.

Finally, most municipal 911 ALS services do not have the same available materiel capability as transfer ALS services. In Massachusetts, 911 services do not carry and maintain intravenous infusion pumps or transport ventilators. Patients requiring these additional capabilities would be inappropriate for the municipal ALS service. The local cardiac catheterization program does not require patients to be transported with intravenous infusions of heparin or other anticoagulants. This is based on available evidence, which demonstrates the absence of outcome differences between patients treated with bolus-only anticoagulants as compared to bolus plus infusion anticoagulants in the context of STEMI.[23]

Conclusions

In the proper context, utilization of a municipal "911" ALS service for transport of STEMI patients from transferring hospitals to PCI centers can reduce the overall patient presentation to catheterization lab arrival time. Systems considering this approach should consider the overall volume, geography, and availability of local ALS resources before implementation.

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