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## Featured Article

## 2016 Air Medical Transport Conference Abstracts



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## ORAL &amp; POSTER PRESENTATIONS

### A Multifaceted Transfer Protocol Reduces the Door-in to Door-out Time for STEMI Patients Requiring Interhospital Helicopter Transfer

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**Introduction:** For the half a million patients with ST-segment elevation myocardial infarction (STEMI) who present to Emergency Departments every year, timely percutaneous coronary intervention (PCI) is the preferred treatment. 1, 2 Current guidelines recommend that the time between first medical contact with Emergency Medical Services (EMS) and PCI should be less than 90 minutes, as this timeframe is associated with a significantly decreased rate of morbidity and mortality.1, 2 Because not every hospital is PCI capable, many patients require interfacility transfer, often via helicopter EMS (HEMS). 2-4 The need for transfer often causes delays in definitive treatment.

The Door-In to Door-Out (DIDO) interval is the time that a STEMI patient spends in the emergency department of a non-PCI capable hospital awaiting transfer to one that is PCI capable. 5 Methods to increase the efficiency of tasks required for interfacility transfers are likely to decrease DIDO times. The principal goal of this study is to determine whether a tailored transfer protocol reduces DIDO times for STEMI patients requiring interfacility transfer for PCI.

**Methods: Study Design and Setting:** This was a retrospective observational study involving a historical control group and an intervention group consisting of STEMI patients transferred by a single hospital-based HEMS agency for PCI. Throughout both study periods, the HEMS agency operated two bases and performed transfers throughout a region that has five competing health systems. The service area in the control group includes 16 referring, non-PCI hospitals and 6 accepting hospitals. The intervention group includes 17 referring hospitals and 7 accepting hospitals. The institutional review board approved the study.

**Selection of Participants:** DIDO times for historical control subjects were obtained from a previous study detailing HEMS transfers of STEMI patients in 2007, which examined the proportion of STEMI patients transferred by a HEMS system who made the recommended 90 minute door-to-balloon time for transfer for PCI.4 Eligible subjects for the intervention group were identified through the computer-aided dispatch and clinical charting database of the HEMS agency, Golden Hour Live

(Golden Hour, San Diego, CA). This database contains all patients flown by the HEMS agency, as well as subject demographic information and the transfer time intervals required to compute DIDO.

Patients eligible for the intervention group were flown from March 2011 through December 2012 with a flight originating at the emergency department of a non-PCI capable facility routing to a PCI capable hospital within the regional health system, and patient ages 18 years or older. Patients diagnosed with STEMI by the referring emergency department physician were included. Patients transported for reasons other than STEMI as well as those STEMI patients not taken directly to the catheterization lab in the accepting facility were excluded.

**Interventions:** Several modifications to the interfacility transfer process of STEMI patients were made based, in part, on our previous experience.4 Under the historical protocol by which the control group patients were managed, HEMS could only be requested after all transfer arrangements were made. In contrast, for the intervention period, a helicopter could be dispatched to the referring hospital before an accepting hospital or cardiologist was identified. In the event that no accepting cardiologist was found prior to HEMS departure with the patient from the referring hospital, patients were transferred to a pre-arranged default PCI center. This modification was designed to decrease the time from STEMI diagnosis to HEMS request.

To reduce at-bedside time by the HEMS crew, a “limited medication drip” policy was also implemented simultaneously during the intervention period. Historically, any medication being infused by the referring ED upon HEMS arrival would be continued during the flight, requiring switching these medication drips from ED infusion pumps to transport pumps. Because this process can be time consuming, and since many medications have a duration of action that exceeds average transport time, only antiarrhythmics, vasopressors, and fibrinolytics were continued in flight during the intervention period.6 Those medications that had pharmacokinetics that could safely allow for a brief stoppage (i.e. heparin, eptifibatide, nitroglycerin) were discontinued for the duration of the HEMS transport.

Finally, to reduce ground delays related to aircraft start-up and shut-down procedures, the intervention protocol encouraged loading and unloading of STEMI patients undergoing interhospital transfer for PCI with the helicopter rotors running, as long as the transport team felt that it was safe to do so. Prior to the intervention period, such “hot-loading and hot-unloading” practices were rarely done for STEMI interhospital transfers.

**Methods and Measurements:** The methods of data abstraction for the control group have been previously described.<sup>4</sup> Briefly, patient information relevant to the study was obtained from the 16 referring hospitals, records from the previous in-flight electronic database, AeroMed (Innovative Engineering, Lebanon, NH), as well as documentation from the 6 accepting hospitals. All charts were dually abstracted.

For the intervention group, discrete data elements were exported electronically directly from the HEMS clinical database. Patient care reports were abstracted following previously published standards.<sup>7</sup> Cases underwent dual abstraction onto study specific case report forms supported by a data dictionary. A third reviewer resolved discrepancies between the two abstractors. No abstractors were blinded to the objective of the study.

**Primary Outcome:** The primary outcome is the DIDO time. The door-in time was defined as the time the patient first arrived at the referring facility. To obtain the door-in and diagnostic EKG times, HEMS transfer teams had to obtain them from the referring facility's medical records. They were then entered into the HEMS clinical database with the patient transfer reports. Door-out was defined by the HEMS transport medical record as the time the patient departed with the HEMS team from the referring hospital emergency department en route to the helicopter—specifically, the time when the HEMS stretcher began moving out of the patient's room in the referring ED. In cases in which multiple EKGs were done, the diagnostic EKG was defined as the first EKG deemed by the referring emergency physician to be diagnostic of STEMI.

**Analysis:** The Mann-Whitney U-Test was used to compare differences in medians and 95% confidence intervals were calculated based on the method proposed by Bonett & Price (2002).<sup>8</sup> All statistical analysis was conducted using SPSS 22.0 (IBM Corporation, Armonk, NY).

**Results: Characteristics of Study Subjects:** Table 1 describes the 417 subjects included in the study (179 control and 238 intervention group subjects). Six patients were excluded from the intervention group due to missing door-in time.

There was no significant difference demographically between the two groups. The mean age of patients in the study was 59 years (SD=14). Patients were predominantly Caucasian (339 of 417; 81%) and male (275 of 417; 66%).

**Main Results:** The median DIDO time was 15 minutes shorter in the intervention group than the control group (68 vs 83 minutes; 95% CI of difference -21 to -8 minutes, Figure 1). The time interval of diagnostic EKG-to-HEMS request was reduced by 21 minutes (35 vs 14 minutes, 95% CI of difference -25 to -17 minutes). HEMS ground time (HEMS arrival to HEMS departure) was reduced by 3 minutes (20 vs 17 minutes, 95% CI of difference -4 to -2 minutes) (Table 2). The time interval of patient arrival (door-in) to the diagnostic EKG was not significantly different between the two groups (8 vs 5 minutes, 95% CI of difference 1 to 5 minutes; Figure 2). Our strategy in refinement of our transfer protocol focused on the intervals of DIDO that are under the control of the HEMS agency. The Door-to-EKG interval is solely managed by the referring hospital.

**Limitations:** Our data suggest that a multifaceted intervention can reduce the DIDO time for patients transferred by HEMS for the purposes of PCI. However, our findings should be interpreted in the context of its limitations. A primary concern is that data were recorded primarily for clinical purposes. The time intervals for flight segments are reliable because the HEMS database used FAA-reportable information. The accuracy of ED arrival time in the intervention cohort was not verified by primary review of the medical records of the referring hospital, as was done for the control group. While the new transfer protocol encouraged patient loading and unloading with the helicopter rotors turning, whether or not this occurred was not documented; our results may

minimize the achievable reduction in time intervals if this aspect of the intervention was not universally followed.

The door-out time in the historical cohort group was defined as the time of helicopter takeoff from the referring hospital with the STEMI patient. The post-implementation definition of door-out was used to synchronize with the currently accepted definition of DIDO, the time of patient departure from the referring ED with the HEMS team. Consequently, a slight overestimation in the effect of the new protocol may have resulted.

In the final five months of the intervention period, the HEMS service replaced two BK117 helicopters with EC145 helicopters. These new models have a maximum velocity estimated to be about 17 knots (19.6 mph) faster than the previously used model BK117s, which may account for some of the observed differences. Because the majority of flights in the service area is relatively short (< 30 miles) and were flown with the BK117, this potential effect is thought to be small.

**Discussion:** The implementation of a multifaceted protocol for the HEMS transfer of STEMI patients from non-PCI capable hospitals to a hospital with a catheterization laboratory resulted in a median 15-minute reduction of Door-In-Door-Out time.

Reductions in time to reperfusion are correlated with improved outcomes in patients with STEMI. Because the DIDO time represents time spent at the non-PCI hospital awaiting transfer, it is of no surprise that reductions in DIDO times are also correlated with improved mortality.<sup>5</sup> As part of an overall system of care, streamlined transfer processes may result in more patients receiving definitive care within guideline times.

Previous reports have shown that regional systems of care, with pre-arranged interfacility transfer agreements, can result in improved reperfusion times for STEMI patients.<sup>9-10</sup> These results can be difficult to implement in regions with multiple competing healthcare systems or without regionalization.

We found modest time reduction by limiting activity by the HEMS team in the referring hospital's ED, assumedly via the limited drip policy. The most significant time savings in our study occurred by encouraging HEMS request at the time of first STEMI diagnosis, instead of following confirmation of an accepting interventional cardiologist and PCI-capable hospital, denoted by the decreased EKG-to-HEMS request interval. Because this is an operational change at the discretion of the HEMS agency, implementation was straightforward and could be replicated outside of our system. Outreach and re-education of referring non-PCI capable hospitals was performed. We did identify a default PCI center that could be used if an accepting cardiologist could not be secured prior to HEMS departure from the referring hospital, but this rescue option was seldom needed. This low default center necessity has a twofold benefit which predicts both the protocol's sustainability as well as its potential appeal and utility in other regions: in the overwhelming majority of cases, the patient receives care at their preferred PCI center and there is not significant diversion of patients outside of usual referral patterns between non-PCI and PCI-hospitals.

**Conclusion:** We found that operational changes by a HEMS agency can reduce DIDO times in STEMI patients requiring interfacility transfer for PCI, even in a region with multiple competing health systems.

#### **PTSD: The Long Journey**

*Reuben Farnsworth, NRP, CCP-C — Rock Star Education and Consulting*

Some therapists place the occurrence of PTSD in field medics as even higher than combat veterans. While our military personnel

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