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Development of an implementation plan for a STEMI quality assurance surveillance program within Delray Beach Fire-Rescue

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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Abstract

The problem was that Delray Beach Fire-Rescue (DBFR) did not have a surveillance program within its Emergency Medical Services (EMS) Division for ST Segment Elevated Myocardial Infarction (STEMI) patient care, protocol review, and procedures. This problem resulted in the agency's inability to document the efficacy of the various EMS programs, training initiatives, patient care protocols, treatment modalities, or analysis of patient mortality and/or morbidity. The purpose of this research was to identify the criteria needed to measure the efficacy of a STEMI quality assurance (QA) surveillance program within the EMS Division of DBFR. The research was conducted using descriptive research methods to answer the following research questions: What hospital-based industry standards for documenting STEMI patient outcomes exist? How do other Fire/EMS agencies document STEMI patient outcomes? What components need to be included in a STEMI surveillance program? What are the perceived costs/benefits of conducting these assessments? The research was conducted utilizing journal and periodical review, personal interviews with local and nationwide EMS administrators, a survey of Fire/EMS agencies, and statistical analysis. The survey was conducted nationally for a comparative analysis of what strategies different agencies utilized for the treatment and transport of STEMI patients and specifically what benchmarks and quality assurance initiatives they had instituted. The literature review, personal interviews, and survey identified a number of methods used by other fire departments and EMS agencies to gather STEMI data. The recommendation that resulted from this research indicated that a sustained and proactive STEMI QA program should be instituted at DBFR. Specific recommendations detailed a program that was independent of local hospitals, but inclusive of their data as well as response time and patient

outcome data. All QA would be shared with DBFR personnel, citizens of Delray Beach, and with local hospitals.

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Appendices

Introduction

Fire departments and EMS agencies have evolved in the past several decades to the point that these units are often described as “mobile EDs.” The trained professionals who provide these services are trained to treat an ever increasing array of patient complaints, including trauma, respiratory afflictions, drug overdoses, pediatric emergencies, and cardiac emergencies. While each of these patients presents a unique challenge to the rescuer, the patient experiencing a cardiac event poses a challenging race against time. In the cardiac realm, the term “time is muscle” has helped to steer patient care protocols, technological advancements, and the development of treatment teams.

Within cardiology, there are primarily two different diagnoses for patients experiencing a myocardial infarction (MI) or heart attack. Commonly, these are referred to as STEMI and Non-ST Segment Elevated Myocardial Infarction (NSTEMI). The ST segment refers to one of the components of an electrocardiogram, also known as an EKG. Patients who are experiencing a heart attack typically have elevations noted in this particular segment of their EKG. These changes, in conjunction with the patient’s medical history, vital signs, medical complaint, and clinical presentation, result in a confirmed STEMI diagnosis. The American Heart Association (AHA) estimates that there are 1.4 million heart attacks per year. Of these, approximately 400,000 are of the STEMI variety (The Need: Mission Lifeline). Patient outcomes depend on a number of factors, including age, cardiac history, correlating location of the STEMI in relation to heart muscle, and time of onset of symptoms versus time of definitive treatment.

The AHA, American College of Cardiology (ACC), Centers for Medicare and Medicaid Services (CMS), and a number of other agencies have conducted research and studies over a number of years aimed at producing a best practices model for the timely care of these patients.

In conjunction with this research, the advent of technologically refined equipment such as Bluetooth 12-lead EKG telemetry transmission, prehospital cardiac enzyme detectors, and Continuous Positive Airway Pressure (CPAP) has assisted both EMS and hospital-based providers with rendering improved care which has resulted in better patient outcomes.

Like most fire-based EMS agencies across the country, DBFR has strived to provide scientifically sound and progressive medical care to STEMI patients. DBFR employs not only Bluetooth 12-lead EKG telemetry transmission, prehospital cardiac enzyme detectors, and CPAP, but also intravenous Nitroglycerine and other pharmacological-based treatments aimed at improving STEMI patient outcomes.

The problem is that DBFR does not currently have a STEMI surveillance program within its EMS Division, and thus no way to document the efficacy of the various EMS programs, equipment, training initiatives, patient care protocols, treatment modalities, or analysis of patient mortality and/or morbidity. The purpose of this research is to identify the criteria needed to measure the efficacy of a STEMI quality assurance surveillance program within the EMS Division of DBFR.

The author of this applied research paper will utilize descriptive research and the following four questions to guide the researcher's efforts: What are the hospital-based industry standards for documenting STEMI patient outcomes? How do other Fire/EMS agencies document STEMI patient outcomes? What components need to be included in a STEMI surveillance program? What are the perceived costs/benefits of conducting these assessments?

Background and Significance

The City of Delray Beach is located in Palm Beach County on the east coast of Florida. The population of DBFR's service area is approximately 65,000 and is demographically

and economically diverse and is geographically made up of 17 square miles. During the winter months, the population swells to nearly 80,000 with part-time elderly residents who reside primarily in the western corridor of the City. DBFR provides fire suppression, advanced and basic life support services including transportation, prevention, inspection, education, special operations, and other community-based services. In addition, DBFR contractually provides its services through interlocal agreements to two neighboring municipalities: Highland Beach and the Town of Gulf Stream. DBFR has existing mutual aid agreements with Boynton Beach, Boca Raton, and Palm Beach County. The department's annual operating budget is just under $20 million (DBFR annual report, 2010).

DBFR is a paid career department that has 146 personnel, of which 137 are certified firefighters (DBFR annual report 2010). The Department has six stations and operates with a daily minimum staffing of 32 personnel. In fiscal year 2009-2010, DBFR ran a total of 11,960 emergency service calls, for which 79.5% or 9,508 were EMS-oriented. Of the 9,508 EMS calls, 6,308 or 66% resulted in transportation of the patient to a local ED.

Organizationally, DBFR has a total of nine Chief Officers: Fire-Rescue Chief, two Assistant Chiefs (Operations and Administration), three Battalion Chiefs, and three Division Chiefs. One Division Chief oversees the Training and Safety Division, another oversees the Emergency Medical Services Division, and the third oversees the Fire and Life Safety Division. The average tenure of the current DBFR Chief Officers is 18.1 years. However, seven of the nine Chief Officers have been in their positions for less than five years.

DBFR is also responsible for the emergency management and planning for the City of Delray Beach. The Emergency Operations Center (EOC) is housed at fire headquarters, is

staffed by various city personnel, and is run under the auspices of the National Incident Management System (NIMS).

In fiscal year 2009-2010, DBFR responded to a total of 2,301 calls listing "chest pain" as the patient's chief complaint. Of these, 2,270 received a 12-lead EKG and twenty six of these patients met "cardiac alert" criteria. This criterion denotes patients who are experiencing chest pain, have unstable vital signs, have a history of cardiac issues, and have ST segment changes on their 12-lead EKG in two or more related leads. STEMI patients are only transported to facilities that have cardiac catheterization capabilities.

DBFR has been providing EMS transport for patients since 1995. In the past sixteen years, the number and type of EMS transports has grown steadily and in some instances substantially. For example, in 1995, DBFR units transported a total of 3,675 patients. Four years later in fiscal year 1999-2000, the number of transports increased to 4,497. Finally, in 2009-2010, the number of transports was 6,308, indicative of a 41.7% increase from 1995 (DBFR Annual Report 2009-2010). These numbers are reflective and proportionate to census data and demographic changes in the city. In 1990, the population of Delray Beach was 47,181 and by 2009, the population had increased to 64,691.

In 1966, the National Academy of Sciences published a report entitled Accidental Death and Disability: The Neglected Disease of Modern Society. The relevance of this report is that it brought to light the number of traffic-related deaths and disabilities that had taken place during that era and also highlighted the deficiencies in prehospital care in the United States. The paper made recommendations regarding ambulance systems, including "a call for ambulance standards, state-level policies and regulations, and adopting methodology for providing consistent ambulance services at the local level." (EMS history). The Highway Traffic Safety Act of 1966

established the U.S. Department of Transportation (DOT) and tasked this entity with improving EMS education and training standards.

In the forty five years since 1966, Emergency Medical Services (EMS) delivery within the United States as an organized and recognized entity has developed into a cutting edge and standardized profession. The evolution of EMS has been swift with marked technological improvements, enhanced pharmacological administration in the prehospital setting, treatment protocols that mirror patient care objectives set forth by local EDs, and the use of advanced interventions. From the early days of "scoop and go" patient care to modern day implementation of induced hypothermia for post-cardiac arrest patients and prehospital telemetry, the relatively rapid advancements within the field of EMS have been impressive.

Like many agencies across the country, DBFR has strived in the past ten years to be proactive in patient care, notably with STEMI and other cardiac patients. The department has procured equipment through the budget process, grants, and community donations that has resulted in improved Paramedic performance, and ultimately patient outcomes, as well. For example, in the fall of 2007, Delray Medical Center (DMC) purchased Bluetooth technology for all of DBFR's EKG/defibrillators. After all of the equipment received this retrofitted equipment, they had the capability to transmit problematic 12-lead EKG's from the field, whether a patient's residence, a business, or a public location, to the local ED. In addition, transmittals could be made to a physician's Smartphone or to remote sites for immediate interpretation. Without this technology, physicians and their staff were reliant upon the correct 12-lead interpretation by field Paramedics. By transmitting the EKG while still on the emergency scene, staff, equipment, medications, and in some instances the cardiac catheterization lab could all be prepared for the patient upon their arrival. At DMC, for example, the cardiac catheterization lab has standard

daily hours of Monday through Friday from 0700 to 1500 hours. Evening and weekend hours are handled by on-call personnel who must first drive into the facility after receiving a page for an emergent case (F. Collins, personal communications, March 2, 1011).

The totality of the DBFR's efforts are not limited to equipment procurement. Annual EKG training, monthly EMS training, protocol development and review, and patient care report (PCR) quality assurance have all been instituted by the EMS Division. The department presently uses EMSPro software for PCR documentation, and submits monthly data to the State of Florida under the auspices of EMS Tracking and Reporting System (EMSTARS). With regard to STEMI patients, there currently are no benchmarks or mandates on treatment or transportation times that the department must adhere to.

This research is aligned with the United State Fire Administration's (USFA) strategic goals of improving the fire and emergency service's capability for response to and recovery from all hazards, and improving the fire and emergency services' professional status (USFA Strategic Plan, 2010). This research is also aligned with the course goal of Executive Leadership (EL) that states, "The chief fire executive will develop the ability to conceptualize and employ the key processes used by effective executive-level-managers." (Executive Leadership student manual, p. v).

Literature Review

The human heart is the organ responsible for blood flow throughout the body. The heart is comprised of a total of four chambers: two atria and two ventricles. These are referred to as the right and left atrium, and the right and left ventricle. Blood arrives at the heart via the superior and inferior vena cava into the right atrium in a deoxygenated state. Each chamber has a specific function with the goal being the transformation of the body's blood from a

deoxygenated state to an oxygenated state. Once the blood has reached the ladder, it is expelled from the heart to the body by the aorta (Anatomy and physiology).

The coronary arteries are responsible for the blood supply to the heart muscle itself. These arteries - the right coronary artery, the posterior descending coronary artery, left main coronary artery, left anterior descending coronary artery, and the left circumflex coronary artery - literally surround and encompass the heart. (http://www.medterms.com/script/main/art.asp?articlekey=7250). Myocardial infarctions, or heart attacks, occur when excessive plaque builds up within one or more of the coronary arteries inhibiting its blood flow to the heart. Consequently, the underlying cardiac muscle suffers an episode of oxygen deprivation. Any sustained period of time that cardiac muscle is denied oxygen results in ischemia, or an injury to the muscle. Prolonged oxygen deprivation results in muscle necrosis, or death. Unlike other muscles in the human body which can recover from injury, the cardiac muscle never regenerates.

Cardiologists use a battery of tests to diagnose their patients. These include: EKG, cardiac catheterization, laboratory tests, CT scans, Magnetic Resonance Imaging (MRI), and stress tests. In the prehospital setting, EKG's are the primary test used to determine if there are any electrical abnormalities occurring with a patient. Measurements are taken from key intervals points in the EKG, and these measurements assist with diagnosing patients with heart attacks. The letters used in EKG interpretation are P, Q, R, S, and T. The segment between P and R, for example, is referred to as the PR interval and is indicative of the time needed for a heartbeat to circulate throughout the entire atria. Problems or delays with this interval reflect a disturbance in the normal conduction pathways. The segment between S and T, referred to as the ST segment, times the difference between depolarization and repolarization of the ventricles. Measurements

of the ST segment above the baseline in two or more related EKG leads confirms a diagnosis of STEMI (Lewis, 2000).

The prevalence of STEMI in the United States has reached 500,000 new cases per year (Anbe, Armstrong, Bates, Green, & Hand, 2009).

Common patient signs and symptoms of a STEMI include chest pain or discomfort, shortness of breath, weakness, diaphoresis, nausea and lightheadedness. Contributing risk factors include smoking, hypertension, obesity, stress, and significant family medical history associated with heart disease.

The treatment options for a patient experiencing a STEMI are differentiated between the prehospital setting and the inpatient setting. Both of these settings are intended to be cohesive and not meant to be mutually exclusive. The AHA is the definitive resource for clinicians and laymen alike for all cardiac matters. Since there is a direct correlation between the time of the onset of symptoms and the time of treatment to the patient's outcome, time is a commodity that is inclusive in each of the plans.

In the prehospital setting, Paramedics are trained to recognize not only the signs and symptoms of a STEMI, but also EKG changes indicative of a STEMI. The staples of treatment for these patients include oxygen therapy, 12-lead EKG, intravenous line, medication administration that would include aspirin and nitroglycerine, and rapid transportation to a facility that has cardiac catheterization capabilities. An additional care option is fibrinolysis in the prehospital setting. Fibrinolysis consists of administering medications aimed at dissolving a clot within a coronary artery. Not all patients are viable candidates, and administration of the medication is dependent upon transportation times and risk factors to the patient (Anbe, Armstrong, Bates, Green, & Hand, 2009).

The ACC and AHA joined together to update their practice guidelines for STEMI patients in 2004. In their best practices model, the treatment options for STEMI patients were broken down into three distinct classifications. The overall goal is to minimize the ischemic time of the heart to a period less than 120 minutes. First, fibrinolysis should be administered within thirty minutes of EMS arrival on scene if it is available to Paramedics and if there are no contraindications for the patient. Second, if fibrinolysis is not available to Paramedics and the patient is transported to a facility without cardiac catheterization capabilities, then fibrinolysis should be started within thirty minutes at the receiving hospital. Third, if fibrinolysis is not available to Paramedics and the patient is transported to a facility with cardiac catheterization capabilities, the hospital's door-to-balloon (D2B) time should be within ninety minutes (Anbe, Armstrong, Bates, Green, & Hand, 2009).

Within a hospital setting, there are a number of interventions and treatment options for STEMI patients that are dependent upon the patient's medical history, current condition, onset time of symptoms, and technology availability. Hospitals may be able to offer fibrinolysis, percutaneous coronary intervention (PCI) or cardiac catheterization capabilities, and Coronary Artery Bypass Graft (CABG) or open-heart surgery abilities. Some hospitals are able to offer one or two of these interventions, while other facilities will be able to offer all of these services (Cox, Stone, Grines, & Stuckey, 2006). A hospital's service availability factors in to where an EMS agency transports their STEMI patient.

A door-to-balloon (D2B) time of less than ninety minutes is the established goal for STEMI patients. Specifically, the D2B measures the time from when a STEMI patient arrives at a hospital or emergency to the time when the affected coronary artery is perfused either by cardiac stent or balloon placement (D2B Sustain the Gain, 2011). This established timeframe

has gained credibility in both emergency and cardiac medicine. Both the CMS and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) have identified these various time measurements as core quality measures to be collected and analyzed (Bradley, Herrin, Wang, Barton, & Webster, 2006). A variety of strategies have been implemented by hospitals to reach this goal. For example, some facilities have adopted the policy of directing ambulance crews to transport STEMI patients directly to the cardiac catheterization lab. The philosophy is that no time will be wasted in the ED and care will be expedited. Other hospitals have taken to assigning a core team of emergency personnel that care for the patient upon arrival and expedite the appropriate testing and expedite the process of preparing the patient for the catheterization laboratory.

A key component of the entire D2B concept and patient outcome is the prehospital efforts of Paramedics and the entire EMS system. Timely EKG's and correct interpretation prior to arrival at the hospital are crucial in reducing the overall treatment time of STEMI patients. Research has indicated that transmitting the EKG to the receiving facility from the field can reduce up to thirty minutes off of the ninety minute D2B goal. Patients who are experiencing a STEMI can access healthcare either via an ambulance or by driving themselves to the hospital. The advantages to early activation of the 911 and EMS systems are evidenced by study results published in the January 2010 issue of *Catheterization and Cardiovascular Interventions.* In the cited study, 97.4% of all patients who had a prehospital ECG performed had a D2B time within ninety minutes, as opposed to only 61.5% who did not have an ECG until their arrival at the hospital (Neale, 2010). A different study conducted in 2006 indicated that proper prehospital STEMI diagnosis and referral directly to a catheterization lab resulted in D2B times of less than

ninety minutes in 82% of all cases (Vermeulen, Jaarsma, Hanenburg, Nannenbert, Jessurun, & Zijlstra, 2008).

Having 12-lead EKG capabilities in the prehospital setting and accurately interpreting the rhythm strips are two separate matters. Many hospitals and physicians will only activate the catheterization lab after either an emergency room physician or a cardiologist has reviewed the 12-lead EKG. Paramedic interpretation of the EKG's has been an issue for STEMI programs. False or inaccurate readings have resulted in opening the catheterization labs unnecessarily, which has staffing and fiscal impacts. Studies have been conducted for a comparative analysis of STEMI diagnosis by Paramedics versus doctors. In one study, for example, Paramedics were 78% accurate in diagnosing STEMI on an EKG, compared with 96% for doctors. This same study reported that there was a 22-30% false activation rate for the catheterization lab by Paramedics (Slovis, 2011).

The D2B Alliance was created in 2006 as a means of encouraging collaboration between physicians, clinicians, administrators, and healthcare professionals to standardize and improve STEMI treatments across the country. This alliance has formulated strategies that are designed to expedite the diagnosis and treatment of these patients. Highlights of these strategies include activation of the catheterization lab, availability of the catheterization team and an interventional cardiologist within thirty minutes, and access to a prehospital 12-lead EKG (D2B Sustain the Gain, 2011).

Jim Keigan is an Assistant Chief with the Madison Fire Department in Madison, Wisconsin. The Madison Fire Department is a full service career department. In 2010, the department responded to 20,000 EMS calls, 13% of which were cardiac related. Within their response area, there are three hospitals and all are STEMI certified. When responding to these

calls, Madison personnel communicate with the hospitals that they have a STEMI alert and the catheterization lab is then activated. Prehospital transmission of the EKG's is not conducted by the personnel, citing their relatively short transport times of five to eight minutes as the reason. Statistically, the Paramedics in Madison have been proven to have a 98% accuracy record in accurately diagnosing STEMI patients in the prehospital setting. Each hospital conducts quality assurance on all STEMI patients and the EMS Chief for Madison meets quarterly with hospital staff to review the data and patient outcomes for the specified periods of discharge, six months, and twelve months. Chief Keigan reported that personnel receive EKG training and cardiac continuing education annually, if not more often. An interesting element of the partnership between Madison Fire Department and the receiving hospitals is that patients are transported directly to the catheterization lab, and the Paramedics are encouraged to stay for the procedure, time permitting (J. Keigan, personal communication, February 17, 2011).

Mike O'Neil is the Division Chief of EMS for the Boca Raton Fire-Raton Fire Department (BRFD) in Boca Raton, Florida. Like the Madison Fire Department, BRFD is a career, full service department that provides ALS care, including care and transport of STEMI patients. Chief O'Neil in recent years has implemented a Quality Assurance (QA) program for STEMI, stroke patients, and trauma patients. The goal of his program was to document times and patient outcomes for these specific patient groups. QA benchmarks he sought to document were on scene time, time from rescue crew arrival on scene to arrival at the hospital, Paramedic accuracy in diagnosis, and patient outcomes. In fiscal year 2010, BRFD responded to a total of 40 STEMI calls. Chief O'Neil admitted that his program has been hampered by the receiving hospitals and the associated delays in receiving data. For example, one of the hospitals has cited patient confidentiality and Health Insurance Portability and Accountability Act (HIPAA)

concerns for the delay in data sharing. His agency is able to document their response times, but much of the hospital-based information is lagging. Of the forty STEMI patients in 2010, he is only able to provide patient outcome data on eleven. The Chief also cited concerns by hospital staff on conflicting requests by the various Fire and EMS agencies in the area. The different approaches taken by the various agencies were not in unison and this created confusion and delays in receiving the information (M. O'Neil, personal communications, February 22, 2011).

Dr. Craig Kushnir is the Medical Director for both DBFR and the Bethesda Memorial Hospital (BMH) ED, one of the primary hospitals in DBFR's response area. In 2008, BMH opened the Bethesda Heart Institute (BHI), which provides PCI, Coronary Artery Bypass Grafts (CABG), cardiac rehabilitation, and STEMI care. As director of the ED, Dr. Kushnir meets monthly with the Nursing Director of the ED, the Executive Director and Director of BHI, and the entire QA staff of BHI to review all of their D2B initiatives. During these meetings, all of the time and treatment benchmarks are reviewed. Feedback information is offered to EMS in the way of patient before and after procedure photographs placed in the Paramedic work station for review. No specific data is provided to Fire or EMS agencies on a regular basis, and the prehospital EMS times are not recorded in the patient's chart. The BHI currently has a D2B time of less than ninety minutes 88% of the time (C. Kushnir, personal communications, March 15, 2011).

In Miami, a unique approach was taken by Fire and EMS agencies from a QA standpoint for STEMI patients. In 2006, all of the responding Fire and EMS agencies in the county joined together to form a STEMI Network. Division Chief John Gardner with Miami Dade Fire Rescue (MDFR) states that because so many hospitals in the county were not meeting the required D2B times, the departments unified and standardized their efforts, involved the Chief Executive

Officers (CEO's) of the various hospitals, and ultimately authored protocols that allowed EMS agencies to bypass any hospital that did not meet the response guidelines for STEMI care. Presently, there are a total of thirty hospitals in Miami Dade County, and twelve of these are in the STEMI Network. An interesting component of their protocol is that patients who present with signs and symptoms of a STEMI but who do not meet the criteria are still transported to the STEMI hospitals under a high index of suspicion. Every STEMI patient receives a thorough QA analysis and a file is created that includes the EMS PCR, ED report, PCI before and after photos, DVD of the catheterization, and follow up forms for the responding personnel. Of all the measurements and data recorded, patient mortality presents the most evidence that the program is working. Prior to the implementation of the network, patient mortality from the time the cardiac catheterization was performed to discharge was 12%. As of 2011, this number has dropped to ½% (J. Gardner, personal communications, March 15, 2011).

Procedures

The researcher utilized descriptive research on several different sources to develop the research base in order to provide answers to the research questions. The search for information germane to STEMI quality assurance programs began at the National Fire Academy's Learning Resource Center (LRC). There were a number of journal articles and reports that gave information and an overview of STEMI, hospital standards, and EMS best practices. Also, a review of DBFR's administrative policies and SOG's was conducted, as was an analysis of the DBFR Annual Report and training records.

A survey was prepared and conducted during the course of the research timeframe, as well. The survey was distributed through the use of www.surveymonkey.com and was sent out on March 5, 2011. This survey was sent to local and regional fire departments in Palm Beach

County through the Fire Chiefs Association of Palm Beach County (FCAPBC). The survey was then sent electronically throughout the State of Florida through the Florida Fire Chiefs Association (FFCA) and finally it was distributed nationally through a link provided by the National Society of Executive Fire Officers (NSEFO). This survey was designed to gather information on STEMI as it relates to EMS from a variety of fire departments sizes and geographic regions. Specifically, information was sought to detail what quality assurance data these agencies were collecting and with what frequency training on EKG interpretation took place. A total of 134 respondents completed the survey. (Appendix A).

Personal interviews were conducted with Division Chief Mike O'Neil of the Boca Raton Fire Department (BRFD) on February 22, 2011, Assistant Chief Jim Kieken of the Madison Fire Department (MFD) February 17, 2011, and Division Chief John Gardner of Miami Dade Fire-Rescue (MDFR) on March 15, 2011. The purpose of these interviews was to determine what initiatives their agencies had instituted, if any, for STEMI quality assurance both within their respective agencies, and with local EDs. The interview included the following questions:

1) Does your department have a quality assurance program for STEMI patients?
2) How many STEMI emergency response calls does your agency respond to annually?
3) What data and times are you collecting with your program?
4) How often are quality assurance reviews conducted?
5) Do your Paramedics receive any patient outcome feedback?
6) How often do your Paramedics receive EKG interpretation training?
7) Does your agency gather data on the accuracy of Paramedic EKG interpretation?
8) Are the receiving hospitals in your jurisdiction capable of providing PCI?
9) Do you find your quality assurance program to be useful?

The following is a list of limitations and assumptions that may have had an effect on this applied research project: the comparatively small amount of research available explicit to STEMI data that is collected in the prehospital setting. Also, given that surveys were used that requested self assessments and opinions, the judgments, attitudes, and perspective of each respondent cannot be quantified.

Results

Research Question #1

What hospital-based industry standards for documenting STEMI patient outcomes exist? There are a number of agencies that have guided and steered STEMI care in the hospital setting. The Society of Chest Pain Centers (SCPC) was founded in the late 1980's to bring standardization to the diagnosis and treatment of cardiac related emergencies by adhering to core measures for STEMI care. The SCPC began an accreditation process for hospitals that provide STEMI care. This particular accreditation process is intended to be holistic and merge all of the various specialties, including EMS and dispatch centers. The aim of the accreditation process is to promote efficient and effective STEMI care and to improve patient outcomes (Society of Chest Pain Centers). The SCPC has established a number of performance measures and outcome measures for STEMI and other myocardial infarction patients. Data is captured, for example, on the thirty day mortality rate for STEMI patients, the thirty day readmission rate for STEMI patients, percentage of patients that receive an EKG in the ED within ten minutes, and whether the patient's initial entry into the hospital was through EMS or through the normal triage process.

The CMS and JCAHO have established quality measures that hospitals adhere to with respect to STEMI care. These established measures are classified as an outcome, process, or structure. These two agencies have worked closely together to develop their measures to avoid

duplicity or contradicting information. The various published measures pertaining to STEMI are separated into two classifications: ED and hospital. One measure states that patients should receive fibrinolytic therapy, when applicable, in less than thirty minutes from arrival at the ED. Another measure states that the emergency physician must initiate communications with the interventional cardiologist within ten minutes of a diagnostic EKG (Quality Measures Compendium: Medicaid and SCHIP Quality Improvement, 2007).

The D2B Alliance is another organization that was developed to "improve the timeliness of reperfusion therapy for patients with heart attacks by facilitating the adoption of evidence and guideline-based best practices." (D2B Sustain the Gain). The alliance was developed in conjunction with the American College of Cardiology (ACC) to help hospitals meet the challenge of meeting the ninety minute D2B performance measure. This alliance has initiated best practices and encourages inclusion and participation by all entities, from EMS to the cardiac catheterization lab. They have created processes for triaging patients, instituted times for EKG collection, and bypassing the ED to expedite treatment.

Research Question #2

How do other Fire/EMS agencies document STEMI patient outcomes? Due to the fact there is no published prehospital STEMI care standard, agencies have approached the quality assurance and continued education of the principles of STEMI in very individual ways. A survey was conducted both within Florida and nationally to ascertain what other agencies have done to gather data, institute continuing EKG education, implement quality assurance measures, and to determine to what extent they are a meaningful part of their local hospital's STEMI team. The survey had a total of 134 respondents. The majority of respondents (70.9% of respondents

were from career departments and agencies ranged in size across the spectrum. Population service areas ranged from 10,001-50,000 (36.6%) to greater than 250,000 (13.4%).

Survey respondents indicated that 82.8% provided ALS care and 44.4% staffed their vehicles with two Paramedics. There are a variety of prehospital tools available for treatment and diagnosis of STEMI patients, although all are not applicable to every agency due to short transport times, funding, or call volume. Some of these tools include cardiac enzyme detectors, intravenous nitroglycerine, and either Bluetooth or modem-based EKG transmission equipment. The Bluetooth technology enables Paramedics to transmit EKG's to the receiving facility from the field, which allows for verification of patient EKG's by a physician in the emergency room and for the timely activation of the catheterization lab. Of the responding agencies, 75% are utilizing Bluetooth technology for transmittal of their EKG's to the hospital.

With regard to hospital communication and involvement, 73% of respondents communicated to the receiving facilities a "STEMI Alert" which means that in the Paramedic's clinical judgment and EKG interpretation, the patient is indeed having a STEMI. Upon arrival at the hospital, the destination of the patient was evenly split between going to the ED for further evaluation and testing (30.4%), directly to the cardiac catheterization lab (30.4%), or the patient is turned over to designated ED personnel, commonly referred to as a STEMI team, for expedited evaluation and treatment (39.2%). For those agencies that have a quality assurance program, 75% conducted patient follow up and data collection from the receiving hospital.

Of the 134 respondents, only 63.7% had an internal quality assurance program to evaluate their patient care and the effectiveness of their training, equipment, protocols, and practices. Specifically, these agencies gathered data regarding response times (89%), patient

outcome (83.5%), coronary artery involvement (46.25), EKG findings (84.6%), medications used (70.3%), and interventions used (78%).

Research Question #3

What components need to be included in a STEMI surveillance program? The ACC, in conjunction with the AHA, has established practice guidelines for the management of STEMI patients. These guidelines are delineated between the time periods of before a STEMI, at the onset of a STEMI, prehospital issues, ED management, hospital management, and long term management. For EMS agencies, the emphasis of these guidelines lies with the prehospital issues.

The guidelines state that all EMS first responders should have a 9-1-1 system with trained dispatchers able to provide basic medical advice to patients. All personnel responding to STEMI patients should be trained in defibrillation and have access to 12-lead EKG technology and the appropriate training, as well as ongoing continuing education and retraining on EKG interpretation. The guidelines are specific that if evidence of a STEMI exists on the initial EKG, Paramedics should have the ability to relay the EKG to the receiving hospital. With regard to prehospital fibrinolytic therapy, this treatment is specifically recommended for instances when there is a medical doctor on the ambulance or when patient transport times are expected to exceed sixty minutes (Anbe, et al., 2004). The guideline further states that STEMI patients should be transported to hospitals capable of performing PCI. In some instances, this facility may prove to not necessarily be the closest facility.

The ACC/AHA states that receiving hospitals should have interdisciplinary teams and best practice-based protocols for STEMI patient care. Treatment for these patients includes an initial patient evaluation, medical history, physical examination, 12-lead EKG and medication

administration that includes aspirin, nitroglycerine, beta-blockers, and analgesia control, laboratory examination, chest x-ray, oxygen therapy, and evaluation for reperfusion therapy (Anbe, et al., 2004). A STEMI QA surveillance program should also include transfer criteria and protocols for receiving facilities that do not have reperfusion capabilities. A percentage of STEMI patients who undergo PCI necessitate further CABG surgery to stabilize their myocardium. Therefore, the ideal destination for these patients would be a facility that has open heart capabilities in addition to PCI.

Patient education is an additional resource important to include in a STEMI surveillance program. Educational topics include smoking cessation, the signs and symptoms of heart attacks, medication administration and potential side effects, dietary therapy, blood pressure control, and weight management. Additionally, family members of the patient should be instructed in CPR and he use of Automated External Defibrillators (AED's) (Anbe, et al., 2004).

Data gathering and review is an important part of a STEMI QA program, as well. Measuring D2B times as well as the inclusion of EMS treatment times should all be evaluated to support positive patient outcomes. Nurses and Paramedics alike have continuing education standards that should include regular EKG interpretation courses.

Research Question #4

What are the perceived costs/benefits of conducting these assessments? The cost of providing prehospital medicine is a challenge for any municipality. Quantifying the cost of caring for a STEMI patient on an emergent basis is no exception. For purposes of trying to elicit a cost versus benefit response, the following information has been gathered from DBFR.

DBFR has a total of six rescue vehicles on duty twenty four hours a day and seven days a week. Additionally, the department has six ALS certified fire engines which can provide

advanced patient care, but cannot transport patients. Often, these units arrive on an emergency scene and stabilize the patient for the incoming rescue unit. All DBFR units are equipped with cardiac equipment that has been procured in the past five years either through the normal budget process, from grants, or from donations by civic groups. The department has a total of sixteen Zoll EKG monitor defibrillators that were purchased at a price of $25,000.00 each. All six transport units, and the EMS Supervisor, have a Zoll Autopulse, which is a hands-free CPR device. The cost of each of these was $15,000.00. The use of IV pumps for medication administration ($26,600.00) and the annual cost of the various cardiac medications ($3,500.00 annually) round out the capital expenses.

DBFR Paramedics undergo annual EKG interpretation training at a fee of $2,400, and subscribe to a monthly EKG newsletter at an additional cost of $1,500. All Paramedics are recertified in Advanced Cardiac Life Support (ACLS) on a biannual basis in the amount of $6,800.00. All of the department's Zoll EKG monitor defibrillators were retrofitted with Bluetooth technology and equipment as a donation by one of the local hospitals in the amount of $30,000.00

Staffing the department's ALS vehicles is expensive, as well. The operating budget for fiscal year 2010-2011 allows for salaries ($7,179,660.00), insurance ($951,000.00), and pension costs ($3,423,700.00). Many of these expenses reflect one time purchases, such as the EKG monitor defibrillators and Autopulses. The total cost of providing cardiac and STEMI care to the residents, business owners, and visitors to the City of Delray Beach is $12,130,160.00.

Between July 2009 and June 2010, a total of 34,924 cardiac catheterizations took place in Florida hospitals. Of these procedures, the average "low" cost was $26,954 and the average "high" cost was $51,420. These costs average out to be approximately $39,000 per case. Using

this average, the total cost for cardiac catheterizations during this time frame was $1,362,036,000.00 (Florida Heath Finder.gov).

Many of the facilities that provide cardiac catheterization are for-profit companies. Municipal fire and EMS agencies, on the other hand, are not for-profit. DBFR bills for all EMS transports and all of these receivables are deposited into the City's general fund. The benefit to fire and EMS agencies providing STEMI care is that these agencies are able to properly care for the medical needs of their citizens. Timely patient evaluation, treatment, and activation of the STEMI alert system, along with being a part of the continuum of care, expedites patient treatment and prevents unnecessary deaths.

Discussion

Fire departments that provide EMS train for a multitude of emergencies and have incorporated preplanning and resident education as key components to their strategic plan. STEMI emergencies are one of several emergencies that EMS agencies must train and prepare for. The AHA has suggested that there are as many as 500,000 new STEMI cases per year (Anbe, Armstrong, Bates, Green & Hand, 2004). Management of these patients has primarily been researched in the hospital setting, where the advanced interventions of PCI and fibrinolytic therapy take place. Significant data has been gathered regarding patient outcomes and best practice models have been developed predicated on the capturing of hospital-based specific time differentials. Because time delays equate to muscle damage for STEMI patients, prompt aggressive care is essential for positive patient outcomes.

The fire service has for many years gathered data on a national level relevant to fires and prevention measures. Statistics are readily available regarding annual number of fires, fire deaths, causes of fires, fire casualties, and structure types through the National Fire Incident

Reporting System (NFIRS). This data is then used to identify trends, costs, and the overall effectiveness of the industry's efforts and training. Likewise, this data is used by fire departments to identify the efficacy of their efforts, procedures, hiring practices, staffing, and equipment.

EMS, on the other hand, has not been as organized or proactive in data gathering. In 2001, the National EMS Information System (NEMSIS) was created to facilitate the implementation of an EMS database (NEMSIS goals & objectives, 2010). The ideology behind NEMSIS is that each state would create its own data gathering system and subsequently submit to NEMSIS for consolidation. However, as of March 2011, only 75% of states had such a system. Thus, accurate nationwide data remains elusive. In Delray Beach, for example, there currently is no data on the number of STEMI patients, outcomes, accuracy of diagnosis, or patient mortality. This lack of data makes it difficult to justify or quantify the efforts of Fire-based EMS agencies.

This research has found that whereas there have been significant improvement in STEMI patient care in the last ten years, prehospital management recommendations and EMS data inclusion is virtually nonexistent. Whereas there are documented time recommendations for the performance of an EKG in the ED setting, the administration of certain medications, and door-to-balloon times, the questions remains: What happens before the patient arrives at the hospital? Indeed, the survey conducted by this researcher revealed that of the 134 respondents, only 64% had a formal QA process for STEMI patients.

At DBFR, significant effort has been made to develop proactive EMS protocols that address the care of STEMI patients, procure advanced technology, and train personnel in EKG interpretation. Despite the use of automated PCR software, no data is captured for STEMI

patients and thus the benefit of these various initiatives is difficult to quantify. More important, the department has no way to validate their efforts or to measure the effectiveness of STEMI patient care.

Interviews with personnel from two of the three hospitals in DBFR's service area reveal that through their respective internal QA programs, not only is no EMS data captured, but little to no feedback is generated either. Although the two entities work together toward the same goal of patient care, they function as two separate entities with little to no data sharing. In DBFR's service area, the QA for STEMI patients has been left to the local hospitals with no EMS involvement.

The approach taken by MDFR is a model for Fire and EMS agencies that render care to STEMI patients. Annually, the STEMI Network is responding to 480-490 patients. Instead of allowing hospitals to take the lead in QA of these patients, MDFR took the helm not only as a patient advocate, but to better be able to steer their efforts, training, protocol development, and treatment. They ensure that D2B times are met by collecting the data themselves and readily bypass hospitals who do not meet the criteria for STEMI patient care and capabilities. Strategically, the Network chose to involve the CEO's of these hospitals directly to ensure their commitment to quality STEMI care and meeting specified times. Some of the HIPAA concerns that are typically cited in information sharing between hospitals and EMS were alleviated by investigating State of Florida QA laws. Chief Gardner states that now that they have gathered data for five years, they have been able to refine their treatment protocols, and statistically justify additional training and equipment purchases (Gardner, 2011).

The care and treatment of STEMI patients is unique in that there are two distinct components that play a role in the patient's outcome: the prehospital and hospital settings.

Hospital-based STEMI care has become gradually refined over the last ten years. Research by the AHA/ACC, data analysis, and the evolution of best practices models have all led to the development of hospital-based protocols whose goal is to improve patient outcomes. A number of time segments are gathered and analyzed, such as time it takes for an EKG to be performed in the ED from the patient's arrival at their door. Another time measurement is from patient arrival to catheterization. Each of these times are carefully compiled and reviewed. Hospitals use these times to measure their proficiency in treating STEMI patients.

Three interviews with three different EMS Chiefs, as well as journal review, reveals that prehospital STEMI care lacks consistency and an overall accepted treatment modality. In some systems, EKG's are transmitted to the receiving facilities, while in other systems they are not. Some agencies have worked closely with their local hospitals to arrange for transportation of STEMI patients directly to the PCI, bypassing the ED completely and saving valuable time. From a data perspective, there are no NEMSIS or national standards on capturing time segments for these patients. A disconnect has developed between the prehospital care and the hospital-based care. The efforts of Paramedics should be incorporated into the overall treatment plan for STEMI patients. The time segments goals for hospitals are important to attain. However, having a D2B of less than ninety minutes is irrelevant if the prehospital care is slow and substandard and has no data to support it.

Recommendations

Based upon a thorough review of information gathered in this study, the following key recommendations are being made for DBFR. It is important that the department do a better job of documenting the efficacy of their treatment of STEMI patients. Whereas the department has instituted proactive EMS protocols and purchased cutting edge technology to specifically address

STEMI patients, there is no data-based evidence to justify the protocols, equipment, training, nor the overall patient mortality and morbidity. DBFR should develop a QA program based upon the MDFR STEMI Network. This program will be managed by the EMS Division Chief with participation by all three shift EMS Supervisors, EMS Training Lieutenant, Medical Director, and local hospital personnel. Inclusive of this program is that data should be collected on all STEMI patients to include response times, scene times, interventions used, EKG interpretation accuracy, demographic information such as age, sex, and race, hospital D2B or time to intervention times, and patient outcomes at discharge and six months. MDFR's program collects patient outcome data and PCI before and after photographs. This information is readily available in most catheterization labs and should be incorporated into the DBFR QA process, as well.

STEMI care protocol should be revised to reflect the need for expeditious care and patient transport to a STEMI facility with total patient times not to exceed thirty minutes. Setting this benchmark is important for establishing a standard within the department. The aforementioned data analysis will help to ensure that this benchmark is being met.

Monthly meetings should occur with all STEMI QA members to review response data and look for improvements. The EMS Chief, Medical Director, and staff will monitor the data, perform chart review, analyze patient outcomes, and perform valuable feedback to the Paramedics. This systematic approach will be useful in justifying additional training, equipment upgrades, and protocol changes. The EMS Chief and Medical Director will also be responsible for doing annual STEMI data presentations to the City Commission and incorporated into DBFR's annual report. Finally, data, patient outcomes, and the entire STEMI QA Program outline will be presented to the Palm Beach County EMS Providers and the Palm Beach County

EMS Council for consideration of adoption. Adoption of this plan at a countywide level would lend itself to a standardization of data collection.

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Appendix A

STEMI Survey and Results

1. Which of the following best describes your agency?
    a. Volunteer 3.0%
    b. Career/Paid 70.9%
    c. Combination 26.1%
2. What is the population of your agency's service area?
    a. < 10,000 6.0%
    b. 10,001-50,000 36.6%
    c. 50,001-100,000 25.4%
    d. 100,001-250,000 18.7%
    e. > 250,001 13.4%
3. How many emergency responses does your agency respond to on an annual basis?
    a. < 10,000 62.9%
    b. 10,001-30,000 22.7%
    c. 30,001-60,000 9.8%
    d. 60,001-100,000 2.3%
    e. > 100,000 2.3%
4. Does your agency provide ALS care?
    a. Yes 82.8%
    b. No 17.2%
5. How many Paramedics does your agency have on a rescue vehicle/ambulance?
    a. 1 34.7%

b. 2 44.4%

c. 3 5.6%

d. Other 15.3%

6. How often do the Paramedics of your agency undergo EKG training/retraining?

a. Semi-annually 20.3%

b. Annually 39.0%

c. Every two years 19.5%

d. Every five years 0.0%

e. Our Paramedics have never had formal EKG training 1.6%

f. Other 19.5%

7. Which of the following does your agency use for the treatment of STEMI patients:

a. Cardiac enzyme detectors 8.7%

b. Bluetooth EKG transmission from the field 75.0%

c. IV nitroglycerine 34.8%

8. Does your agency use “Cardiac Alerts” to communicate with your local EDs for a patient experiencing a STEMI?

a. Yes 73.0%

b. No 27.0%

9. Within your jurisdiction, where is a STEMI patient most likely to be transported to:

a. ED for further evaluation 30.4%

b. Directly to the cardiac catheterization lab 30.4%

c. Patient will be turned over to a cardiac team at the ED 39.2%

10. Does your agency have a quality assurance program that evaluates STEMI patients?

a. Yes 63.7%

b. No 36.3%

11. If so, does your QA program include data collection and patient follow from local EDs:

a. Yes 75.0%

b. No 25.0%

12. What specific information does your QA program include?

a. Response times 89.0%

b. Patient outcome 83.5%

c. Coronary artery involvement 46.2%

d. EKG findings 84.6%

e. Medications used 70.3%

f. Interventions used 78.0%