Determining the Efficacy of Prehospital Cardiac Care Provided by
Milpitas Fire Department Firefighter Paramedics
Richard Frawley
Milpitas Fire Department, Milpitas, California
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.

Signed: ____________________________________________
Abstract

The problem was that the Milpitas Fire Department (MFD) had not evaluated the efficacy of the prehospital cardiac care that was provided by Milpitas firefighter paramedics. As a result, the MFD was experiencing a lack of quality improvement data for critical cardiac patients. This scarcity of objective data would then hinder efforts to validate cardiac patient care, specifically with respect to STEMI (ST-elevation myocardial infarction) situations. According to national standards, these STEMI patients have been identified as requiring rapid identification and transportation to medical facilities that are equipped to treat this type of acute cardiac emergency. The purpose of this research was to evaluate the efficacy of prehospital cardiac care that was provided by Milpitas firefighter paramedics and to determine the quality improvement data for critical cardiac patients. This data was targeted at the evaluation of care for STEMI (ST-elevation myocardial infarction) patients whom were treated by MFD firefighter paramedics. The following research questions were answered in the evaluation of MFD cardiac care efficacy: a) What prehospital best practices have been identified for emergency care of the STEMI patient?; b) what data can validate the efficacy of prehospital emergency care within the MFD for the STEMI patient?; and c) what potential improvements can be applied to MFD STEMI patient care? Research procedures included a retrospective analysis of MFD incident data, departmental interviews, and a questionnaire related to industry best practices. A literature review was also conducted to research STEMI care within the industry. The results indicated that MFD was providing care that is in line with industry best practices. Areas of system improvement were also identified with recommendations for improved paramedic training and data collection.
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Determining the Efficacy of Prehospital Cardiac Care Provided by Milpitas Fire Department Firefighter Paramedics

The Milpitas Fire Department (MFD) responds to calls for medical emergencies as part of an organizational mission to provide service within the community of Milpitas. As part of this mission, the MFD strives to provide a high standard of prehospital advanced life support within an average response time of four minutes prior to the arrival of the ambulance transport. Subjective observations would indicate that this early advanced life support is beneficial to critical patients, such as those who are experiencing cardiac emergencies.

The problem is that the MFD has not evaluated the efficacy of the prehospital cardiac care that is provided by Milpitas firefighter paramedics; as a result, there is a lack of quality improvement data for critical cardiac patients.

The purpose of this applied research project was to evaluate the efficacy of prehospital cardiac care that is provided by Milpitas firefighter paramedics and determine the quality improvement data that is necessary for critical cardiac patients.

This applied research project used an evaluative research method that employs procedures targeting the evaluation and possible improvement of prehospital cardiac care within the community of Milpitas. The purpose of the research was to answer the following questions regarding the efficacy of MLP cardiac care: a) What prehospital best practices have been identified for the emergency care of the STEMI patient?; b) What data can validate the efficacy of prehospital emergency care within the MLP for the STEMI patient?; and c) What potential improvements can be applied to MLP STEMI patient care?
Background and Significance

The Milpitas Fire Department, which serves the 62,000 residents of California’s Silicon Valley, has been providing service to the community since 1954 in what was once pastoral farmland but is now a technology hub. The MFD has four stations staffed with four first responder companies and one aerial apparatus. The MFD has 58 personnel, of which 26 are trained as paramedics in advance life support. The balance of personnel within the organization is trained as emergency medical technicians (Milpitas Fire Department MOU, 2011). As noted in monthly reports to the Milpitas city manager, the MFD responded to 4,316 calls for service in 2010. Out of those calls for service, 63% were emergency medical responses in which care was rendered (Fire Department Monthly Reports, 2010).

The Milpitas Fire Department responds to all emergency calls within the community as a part of an all risk, all hazard plan for response (Milpitas Fire Department Mission Statement). As part of that mission, the MFD responds to all calls for emergency medical assistance within the community. In conjunction with an initiative to improve the level of response to these calls for medical assistance, the MFD initiated an advance life support response capability for the community of Milpitas in 1996 (Interview EMS Battalion Chief, December 2011). Prior to 1996, the MFD provided basic life support. Following the implementation of this higher standard of care, responding engine companies have been subsequently staffed with at least one firefighter trained as a paramedic and two firefighters trained as emergency medical technicians. These apparatus respond to all calls for emergency medical care within the city and initiate
appropriate patient care protocols as directed by the policy and procedure set forth by the Santa Clara County Emergency Medical Services Agency (SCEMSA policy AO8).

The arrival of Milpitas firefighter paramedics allows for advanced patient care to be initiated relatively early in the formative stages of a medical emergency. MLP response goals are arrival times of four minutes from the time of the call for assistance (Fire Department Report to City Council, 2010). MLP paramedics administer patient care and await private ambulance providers, who facilitate patient transport to the most appropriate receiving hospital emergency room. These private ambulance providers are contracted with the Santa Clara County Emergency Medical Services Agency to deliver advanced life support and patient transport.

This service delivery model has been the standard to which prehospital care in Santa Clara County has been delivered during the past fifteen years. However, a recent report by the Santa Clara County Civil Grand Jury has brought attention to this service delivery model. In a report entitled *Fighting Fire or Fighting Change? Rethinking Fire Department Response Protocol and Consolidation Opportunities*, the validity of such advanced life support responses by fire department units was questioned due to the cost of services versus relative efficiencies. The report states that “given that approximately 70% of calls to fire departments are reporting medical emergencies rather than fire, and that only one of every three fire crew members (33%) is trained to respond to medical situations and conditions, there appears to be a mismatch between service needed and service provided” (Grand Jury 2010, p. 6). This statement would dictate that the perception of fire service ALS response in Santa Clara County has not been sufficiently validated.
In light of this Grand Jury report and other relative scrutiny that has been applied to the value of fire service emergency medical services, the Milpitas Fire Department must evaluate the levels of care that are provided to critical areas. One such area of attention are critical cardiac patients within the community. According to Wikipedia (anonymous), a “myocardial infarction (MI) or acute myocardial infarction (AMI), commonly known as a heart attack, results from the interruption of blood supply to a part of the heart, causing heart cells to die” (2011). The problem was that the Milpitas Fire Department had not evaluated the efficacy of the prehospital cardiac care that was provided by Milpitas firefighter paramedics; as a result, there was a lack of quality improvement data for critical cardiac patients within the community. Therefore, it is this researcher’s goal to determine the efficacy of Milpitas prehospital care relative to potentially critical patients and identify data that will improve patient care that is provided to these patients by the Milpitas Fire Department.

One of the more critical cardiac patients that benefits from rapid advanced life support and has also been identified by Santa Clara County Emergency Medical Services as requiring specialized receiving and treatment centers are those patients afflicted by a potentially lethal heart malady known as STEMI (ST- elevation myocardial infarction) (Santa Clara EMSA, 2009). Subjective evidence would indicate that the MFD is providing excellent medical care for these patients, but no indicators of best practices have been developed to evaluate this performance. The purpose of this research is to evaluate whether or not the MFD is validating the efficacy of emergency cardiac care related to the STEMI (ST- elevation myocardial infarction) patient.

This applied research project was directly related to the National Fire Academy’s
Executive Development course, unit 3, Exercising Leadership. As an authority figure and leader within the organization, it is the researcher’s responsibility to exercise adaptive leadership within the organization and identify issues such as the efficacy of patient care. “As a person in authority, a person exercising leadership is expected to establish the agenda and move on issues that need attention” (ED student manual, 2011, p. SM 3-3).

As an adaptive leader, issues such as the validity of patient care require attention. This problem was linked directly to the United States Fire Administration’s (USFA) strategic plan and operational objectives number four (i.e., improve the fire and emergency services’ professional status”) (USFA Web page, 2011). The researcher hopes to improve the professional status of fire and emergency services by determining the validity of the cardiac patient care provided by Milpitas Fire Department Firefighter Paramedics. This information can then be applied to other first responder agencies.

Literature Review

A literature review was conducted to determine previous research in prehospital industry best practices and applicable data points for STEMI care. The literature review was initiated during the Executive Development course at the National Fire Academy. The learning resource center was utilized during August of 2011 to locate the executive fire officer’s (EFO) research papers, periodicals, and publications. This literature review continued through October and November of 2011 via the Internet and local library resources. The key search terms included emergency medical services, fire service prehospital care, cardiac care, STEMI, quality assurance, and quality improvement. Additionally, internal and external governmental policies and procedures were also reviewed.
The first research question, “What prehospital best practices have been identified for the emergency care of the STEMI patient?” was answered through a review of national association publications, prehospital industry periodicals, and local government policy and procedure guidelines.

In researching this question, the reoccurring benchmark of best practices for the STEMI patient continued to focus on accurate, early identification of the STEMI patient, coupled with appropriate treatment and transport. The receiving facilities should be capable of administering advanced care to the patient in accordance with hospital industry standards.

The American College of Cardiologists and the American Heart Association (AHA) wrote the *Revised Guidelines for Management of ST-elevation Myocardial Infarction* STEMI in 2004. The study’s author, Antman et al., further defined STEMI as a significant public health problem in industrialized countries with an estimate of 500,000 STEMI events per year in the U.S (Antman, 2004). STEMI is an acronym that refers to an ST segment elevation myocardial infarction, or a type of heart attack in which a blood vessel in the heart is occluded. In turn, this condition creates an electrical disturbance in the heart. Trained medical providers through the utilization of electrocardiograms can recognize this disturbance. A STEMI patient is determined through the application of an electrocardiogram (ECG) test that can be completed on the scene by paramedic personnel. As identified by the Antman team, the rapid identification of these patient signs will aid in patient treatment and appropriate transport to a receiving facility.

As further described by Ornato in the article “The ST-Segment–Elevation Myocardial Infarction Chain of Survival,” a STEMI chain of survival can enhance the
survival of patients whom access emergency services. In the chain, early access to emergency medical services can aid in the rapid identification of critical patients, followed by appropriate treatment and transport. The early recognition of these patients is an essential component of best practices. As explained in the STEMI Chain of Survival, “Such recognition can be accomplished only by EMS agencies performing a prehospital 12 lead ECG and either interpreting it on scene and or transmitting the ECG to the hospital” (Ornato, 2007). STEMI patients constitute critical cardiac emergencies that benefit significantly from early recognition, treatment, and transport to facilities that are equipped to care for such patients. Therefore, the rapid identification of the STEMI patient is the first step in patient care best practices. The Antman study has further outlined that morbidity and mortality due to STEMI can be significantly reduced if patients and bystanders recognize the symptoms early, activate the EMS system, and thereby shorten the time that is taken to receive definitive treatment (Antman et al, 2004). This statement would further validate that, following early access to emergency services, the logical progression would be early recognition of the signs of STEMI as a best practice.

This type of heart attack has been specifically identified as benefiting from early identification in the prehospital setting. In Studnek’s article entitled “Association Between Prehospital Time Intervals and ST-elevation Myocardial Infarction System Performance”, it was concluded that the early acquisition of prehospital 12-lead ECGs and subsequent hospital notification in patients with symptoms of an acute coronary syndrome is a Class I recommendation that has been shown to reduce time to PCI (Studnek, 2010). Percutaneous coronary intervention, which is the definitive hospital
procedure for STEMI treatment, would indicate that the rapid identification of cardiac
events would improve patient outcomes and is, therefore, identified as a best practice for
STEMI care. A review of the recommendations within the study further supports the best
practices of rapid identification and appropriate notifications of the STEMI patient.
The prehospital time intervals, as defined by the AHA, were as follows:

- 9-1-1 call receipt to ambulance on scene ≤10 minutes.
- Ambulance on scene to 12-lead ECG acquisition ≤8 minutes.
- On-scene time ≤15 minutes
- Prehospital ECG acquisition to ST-elevation myocardial infarction team
  notification ≤10 minutes.
- Scene departure to patient on cardiac catheterization laboratory table ≤30 minutes.

As further identified in the journal *Emergency Medical Clinics of North America*,
in “Prehospital 12 Lead ECG Diagnostic Programs,” Urban states that “‘early reperfusion
significantly reduces mortality and morbidity in patients with acute myocardial
infarction. Prehospital 12-lead ECG programs significantly decrease time to definitive
reperfusion therapy.’” This, in turn, would further indicate that accurate and rapid efforts
are essential best practices in STEMI care.

In 2009, the Santa Clara County EMSA published policy 408, “STEMI Center
Receiving Facility Standards” (SCCEMSA, 2009), in conjunction with field manual A08
“Suspected Cardiac Ischemia.” The goal of these standards and procedures was to create
local identification and standards for hospitals that care for STEMI patients and to
introduce and reinforce appropriate treatment options for prehospital care providers.
These care facilities are known as STEMI centers within Santa Clara County
These STEMI centers have specific requirements and guidelines that have been outlined for the level of care that is to be provided within a medical facility for the STEMI patient. As a stakeholder in the system, the MFD provides care that is listed in these policies and procedures and works in cooperation with transport providers. To that end, the burden of ensuring the appropriate transport of STEMI patients falls equally on both the fire department and private paramedic providers. After initial rapid identification and on-scene treatment, the appropriate transport of the STEMI patient to a STEMI care center is the final benchmark of prehospital best practices within Milpitas.

The second research question, “What data can validate the efficacy of prehospital emergency care within the MLP for the STEMI patient?,” was answered through national association publications, prehospital industry periodicals, and locally published governmental policies and procedures.

As identified in the first research question, “What prehospital best practices have been identified for the emergency care of the STEMI patient?,” the core benchmarks of best practices for STEMI care are the accurate, early identification of the STEMI patient, combined with appropriate treatment and transport. The researcher is tasked with determining the applicable data that can validate the efficacy of STEMI care that is provided by the Milpitas Fire Department.

The MFD strives to follow recognized industry best practices in all facets of operations. The National Fire Protection Association (NFPA) has been recognized as an organization that develops these industry standards. The 2010 NFPA publication, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire*
*Departments,* establishes that personnel deployed to ALS responses shall include a minimum of two members trained at the ALS level and two members trained at the BLS level whom arrive on the scene within the established response time (NFPA, 2010). NFPA 1710 further establishes response times for emergency medical events with an on-scene benchmark of four minutes or less. The researcher can extrapolate that a rapid, on-scene arrival of personnel with the ability to identify STEMI would be a data measurement point of emergency care best practices within Milpitas. The Milpitas model strives to place a three-member crew of ALS and BLS providers on the scene within four minutes. MFD staffing will often provide a crew of three ALS providers whom are dependent on crew assignments. As per the 2010 reports to the city council, the MFD’s average response time of 4:33 seconds closely adheres to this goal. An additional paramedic arrives on the scene via a private ambulance contractor that provides transport, as per Santa Clara County Emergency Medical Services contractual obligations. These specific NFPA recommendations have been outlined below for the EMS response and, as such, provide the basis for best practices data collection.

NFPA 1710 establishes the following response time objectives for EMS:

1. Turnout time of one minute.
2. Four minutes or less for the arrival of an AED-equipped unit with first responder or higher-level capability.
3. Eight minutes or less for the arrival of an advanced life support unit.
4. Performance objective of not less than 90% for each response time.

The researcher can extrapolate that the NFPA-recommended standards could be utilized as data points for the measurement of benchmarks for STEMI care within the MLP.
The National Highway Traffic Safety Administration (NHTSA) commissioned a study in 2009 entitled *EMS Performance Measures: Recommended Measures for System and Service Performance*. This study identified key performance indicators that can be utilized for the evaluation of STEMI patient care. Several of these indicators were applied to patients with suspected cardiac care issues. The three core performance measurement categories with relation to STEMI care are:

- What percentage of patients over age 35 with suspected cardiac chest pain received a 12-lead ECG?
- What percentage of patients over age 35 with suspected cardiac chest pain received an aspirin?
- What percentage of patients with field 12-lead ECG indicated ST Elevation Myocardial Infarction (STEMI) was transported to a hospital with emergency interventional cardiac catheterization capabilities?

The NHTSA study identified benchmarks that emergency medical service providers can utilize to accurately quantify performance and collect statistical information that can assist with the overall validation of system efforts. Additionally, these benchmarks and data points can aid in the post analysis of STEMI patient care events. Individual performance can be identified and acknowledged or improved as necessary to meet these known best practices. As such, these quantifiable performance measurements have been identified as best practice data points for the treatment of the STEMI patients in the Milpitas community.

The American Heart Association has published in its healthcare and research area *Recommendations for Criteria for STEMI Systems of Care*. AHA recommendations state
“Each EMS system should maintain a standardized algorithm for evaluating and treating patients with symptoms suggestive of myocardial ischemia that should include acquisition of a 12-lead ECG and appropriate communication of the ECG findings to the receiving hospital” (AHA Web address, 2011). These touch points can be directly applied to prehospital treatment and data collection. The mechanism for collecting data to support this recommendation can be extrapolated from the AHA EMS criteria that is listed below:

- When taken directly to a STEMI receiving center, all STEMI patients should be transported to the most appropriate facility as determined by Mission: Lifeline hospital criteria, with a system goal of conducting balloon inflation (i.e., the initial device used) within 90 minutes.

- EMS medical director or designate should monitor care related to EMS patients with STEMI by meeting at least quarterly with prehospital providers, emergency physicians, interventional cardiologists, nursing staff, receiving hospital representatives, and other appropriate individuals (i.e., a STEMI survivor).

- The following measurements should be evaluated on an ongoing basis:
  - Symptom onset to 9-1-1 call.
  - The time that the 9-1-1 call is first received by the primary public safety answering point to the vehicle’s arrival at the hospital door.
  - The time from the first medical contact to balloon inflation (i.e., the first device used).
  - The time from the prehospital ECG to balloon inflation (i.e., the first device used).
  - The proportion of patients with non-traumatic chest pain over the age of
35 treated by EMS for whom 12-lead ECGs were obtained.

- Proportion of patients with STEMI treated by EMS for whom 12-lead ECGs were obtained.
- Proportion of patients with field diagnosis of STEMI and activation of the cardiac catheterization.

As explained in O’Connor’s article, “American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care,” “Such recognition can be accomplished only by EMS agencies performing a prehospital 12-lead ECG and either interpreting it on scene and or transmitting the ECG to the hospital.” This has been described as a further development and enhancement to the chain of survival by allowing field information to better prepare the hospital for advanced patient care scenarios.

In an article entitled “Measuring Quality on the Prehospital Care of Chest Pain Patients,” Colwell identifies key outcome measures for the evaluation of cardiac chest pain treatment. These measures included many of the national recommendations that are listed by AHA and NHTSA for care and data collection. One area of note was the trending of aspirin administration: The “administration of aspirin was associated with the lowest compliance rates; this appears to validate previous research that paramedics underutilize aspirin therapy” (Colwell, 2008). As a data collection point within Milpitas, this key factor for STEMI care cannot be overlooked.

In 2009, the Santa Clara County Emergency Medical Services Agency identified policy 408 (i.e., STEMI Receiving Center Standards). This policy outlined the requirements for local hospitals that intended to participate in a high standard of cardiac care. In rapid succession, a field protocol known as “suspected cardiac ischemia” (A08)
was developed for use by field personnel for treating patients with potential cardiac ailments. In this policy, many of the touch points that were previously identified by the national associations and health care researchers were applied to field treatment. The application of this policy by Milpitas field paramedics, in conjunction with increasing demands of case review and accountability, creates the need for data point tracking.

The third and final research question, “What potential improvements can be applied to MLP STEMI patient care?,” was answered through a review of national association periodicals, prehospital industry periodicals, and local agency evaluative publications.

As identified in the second research question, “What data can validate the efficacy of prehospital emergency care within the MLP for the STEMI patient?,” the national and local standards of care have been identified by several recognized organizations. The advanced application of these standards and the accurate validation of performance are essential to identifying potential improvements that can be applied to MLP STEMI patient care. Three areas of possible system improvement were identified during the research. These areas include an increased 12-lead ECG assessment, increased field treatment with aspirin therapy, and improved communication to the receiving hospital.

The possible need for increased 12-lead assessments in the prehospital setting was recognized in Mardell’s article in *Fire Engineering*. In “Improving Fire Service Response to STEMI,” Mardell discusses a significant finding: In the prehospital setting, “fewer than 10 percent of STEMI patients receive an ECG.” This may indicate the varied nature in which patients present and which mechanism enables transport to hospitals (i.e., private vehicles), as well as shed light on a local and possibly global point of
improvement for STEMI care. Care may be enhanced by the increased application and interpretation of the 12-lead ECG assessment tool. This assessment tool would appear to be an underutilized resource in the EMS toolbox. Procedural research may validate this statement within the MLP.

As mentioned in the Colwell et al. article, “Measuring Quality in the Prehospital Care of Chest Pain Patients,” the underutilized patient treatment therapy of aspirin for cardiac chest pain may also be a point of improvement in the care of STEMI patients in Milpitas. An analysis of this data will verify any need for individual or system-wide training to recognize the need to administer this vital medication.

In the article “Further Improvements in STEMI Care Will Come Mainly From Outside the PCI Hospital,” Miller identifies mechanisms to improve care for the STEMI patient. The author referenced that training more ambulance personnel to read ECGs could significantly improve STEMI-patient outcomes (Miller, 2010). Miller further observes that this training could be applied to areas of increased communications between prehospital personnel and receiving hospitals. The author describes a recent project in development in St. Mary’s County in Southern Maryland that will utilize an iPhone application to transmit 12-lead ECG data from the field to the receiving STEMI facility. This process will decrease evaluation time periods in the hospitals and, therefore, improve patient outcomes by enhancing hospital care.

In the executive fire officer research paper *Developing Key Performance Indicators to Improve Patient Care and Outcome at Littleton Fire Rescue* by Zygowicz, the author identified the benefit of evaluating key performance data with reference to the reperfusion of the STEMI event at the receiving facility. The author cited medical
observations that rapid reperfusion is equates to less cardiac damage, shorter rehabilitation time, and reduced medical expenses. Critical outcomes derived from patient care should be examined as potential improvements within an integrated systems approach for STEMI care.

As outlined the article by Lewis et al., “Factors Contributing to Door-to-Balloon Times of ≤ 90 Minutes in 97% of Patients with ST-Elevation Myocardial Infarction: Our One-Year Experience with a Heart Alert Protocol,” the authors outline an area within the study that may justify the enhancement of STEMI transmission to the receiving facility. The authors noted that “heart alert activation by the EM physician while a STEMI patient was en route to the hospital (on the basis of a prehospital ECG report) was encouraged but not mandated. Emergency medical services did not have the ability to transmit prehospital ECGs to our facility during this period” (Lewis, 2010). As this study reflects specifically to the area that comprises Milpitas, this would indicate the possibility of further improving STEMI care and outcomes, not only within Milpitas, but also on a regional basis as part of an integrated system of care.

Procedures

This applied research paper utilized an evaluative research method that employed procedures including a retrospective analysis of Milpitas Fire Department patient care reports, personal interviews with key stakeholders, and a questionnaire on the fire service delivery of STEMI care. These research procedures were developed in order to answer the three core research questions that relate to STEMI care validation within the MFD.

The first research procedure was a retrospective analysis of MFD patient care reports (PCRs) for a portion of the 2011 calendar year to compare MFD data against
industry best practices as identified in the literature review. The review period for
collection was July 1, 2011, through December 31, 2011. The core search criteria were
acute cardiac emergency events, as identified within the patient care report documented
in the departmental record management system known as SunPro (Appendix A).

The second research procedure was a set of personal interviews with system
stakeholders. These holders were the Milpitas Fire Department Battalion Chief in charge
of emergency medical services and the MFD medical director. The purpose of these
interviews was to determine the importance of prehospital cardiac care and the
relationship to the rapid identification and treatment of the STEMI patient (Appendix B).

The third research procedure was a questionnaire on prehospital STEMI care in
the fire service. This anonymous questionnaire was distributed to both local partner
agencies and nationwide fire service entities. It was focused on determining STEMI care
compliance on both a local and national level within the fire service. The goal of the
survey was to contact 50 respondents within a 60-day sample period. This questionnaire
was distributed via referral to a data collection system known as Survey Monkey.
Referrals were made through industry email points of contact requesting participation in
the questionnaire. The request for information was made during December 2011. The
questionnaire requested responses that related to department size, level of response,
STEMI care benchmarks, and STEMI care compliance (Appendix C).

This project had limitations that should be discussed in order to deliver an
unbiased evaluation of the results. The literature resources that were reviewed were
assumed to be unbiased and objective. A wide breadth of comparative sources was an
objective in order to achieve greater probability of unbiased research. The data examined
was limited to emergency medical service calls within the area covered by the Milpitas Fire Department. Data entry within the record management system targeted cardiac chest pain protocol patients. It can be assumed that there may have been patients without medical complaints of chest pain that were subsequently diagnosed with STEMI. Data collection was performed retrospectively and limited to the reliability and accuracy of data input and correct documentation of each patient.

**Results**

The first research procedure was a retrospective analysis of MFD incident data in which the patient care reports within the MFD were scrutinized for a period from July 1, 2011, through December 31, 2011. The total emergency medical responses within this evaluative period were 1,213. These reports were reviewed for on-scene arrival time and cardiac chest pain protocol compliance, as determined through this research project. These results are located in Appendix A.

The criteria that was utilized to evaluate these patient care reports were the recommended data points required for the National Highway Traffic Safety Administration (NHTSA) performance measurements of STEMI care. In addition to these data points, local treatment guidelines from Santa Clara County EMSA Policy A08 (i.e., the suspected cardiac ischemia protocol) were also applied to these patient care reports. These data points were achievable with the current electronic records management system. The performance measures indicated a total of 61 patients whom were included in the cardiac chest pain protocol in the electronic record management system (RMS). Eight patients were excluded from the study as either non-cardiac chest pain or under the previous care of another medical provider. The 53 remaining patients
were all evaluated for field STEMI inclusion and treatment via aspirin administration ratios and 12-lead ECG application ratios.

The administration of aspirin therapy occurred with 46 patients, thus presenting with an 87% compliance with best practices in this performance measure. The compliance ratio of 87% aspirin administration is below the 90% benchmark indicated by NHTSA performance measures.

The application of 12-lead ECG evaluation occurred with 48 patients, thus presenting with a 91% compliance with best practices in this performance measure. The compliance ration of 91% 12-lead ECG evaluation is above the 90% benchmark indicated by NHTSA performance measures. More importantly

Within this data set, 10 patients had been identified as potential STEMI “alert” patients. These patients were identified in the field as requiring additional rapid treatment and transport to a STEMI receiving facility, namely the Regional Medical Center of San Jose (RSJ). All identified STEMI patients were transported to RSJ. This facility is the closest hospital for ambulance transports from Milpitas. These patients all received levels of care that were compliant with both the NHTSA performance indicators and Santa Clara County EMSA Policy A08 or 100% with the suspected STEMI patient.

The second research procedure was a set of department interviews with key stakeholders in the delivery of EMS within the MFD. These stakeholders are the current battalion chief in charge of emergency medical services and the medical director – fire surgeon who facilitates medical compliance within the organization. The interview questions are located in Appendix B.
An interview was conducted on December 1, 2011, with Milpitas Fire Department Battalion Chief Scott Brown. Chief Brown has served the MFD for the past 28 years and has been the paramedic coordinator for the past five years. In addition to training officers and administrative responsibilities, his role within EMS in the organization is to facilitate paramedic duties, evaluations, and education.

The primary focus of the interview with Chief Brown was to identify the current advantages and disadvantages of the STEMI recognition system and to further identify potential areas of improvement within the paramedic and first responder system in Milpitas.

An interview was conducted on January 31, 2012, with MFD Medical Director Howard Michaels, M.D. Dr. Michaels has served as the medical director for the MFD for the past 15 years. He has been an emergency room physician within Santa Clara County for approximately 30 years.

The primary focus of the interview with Dr. Michaels was to determine an expert medical opinion on the value of first responder 12’lead ECG for the STEMI patient and the subsequent potential benefit of early ALS intervention.

Dr. Michaels indentified the core advantages to early STEMI recognition by ALS first responders as being advantages for patients, due to the decreased on-scene time and early identification of the STEMI. This, in turn, allows the transporting ambulance crews to make appropriate hospital destination decisions and to arrive at STEMI centers.

Dr. Michaels further indentified areas of improvement in the field, including increased training for all providers and the ability to transmit on-scene, 12-lead STEMI alert data to the receiving hospital. One particular area of improvement would be to allow
paramedics with a strong index of suspicion to transport patients that do not meet strict STEMI guidelines to STEMI facilities. He further stressed the need to develop the ability for all crew members to be trained to recognize ECG STEMI indicators. This would, in turn, decrease the time to recognize the STEMI patient.

The third research procedure was an industry questionnaire that targeted fire service providers with the intention of determining comparative STEMI care compliance in relation to the size of the organization. The results of this questionnaire are located in Appendix C.

The questionnaire was targeted primarily to fire service EMS providers within Santa Clara County. In addition, questionnaires were also sent out to the greater California fire service for a larger sample group. The questionnaire focused a comparison of STEMI identification and compliance within fire service ALS responders. Although responses to this questionnaire were anonymous, return numbers would dictate that a majority of Santa Clara County fire agencies responded to the survey. In addition, returns were also received from areas beyond Santa Clara County. These results are located in Appendix D.

The results revealed agencies with average service population densities of 100,000 to 200,000. These agencies responded, on average, to 10,000 medical calls for service with an average ALS response times of four to six minutes with staffing levels indicative of an average of 10 fire stations per agency. A majority provided advanced life support in the first responder capability with only two of ten agencies providing transport services.
STEMI data indicated that 70% of respondents evaluated and treated 20 to 100 STEMI incidents per year. This is line with the 10 STEMI cases that Milpitas evaluated in the second half of 2011. The respondents also indicated that 70% of the agencies reached a 100% compliance rate with current treatment protocols in STEMI care. As outlined in the retrospective analysis of data, this response places Milpitas in a comparative level of performance as comparative agencies. In relation to the prehospital identification of STEMI patients prior to transport, 90% of respondents stated that recognition of STEMI patients occurred prior to ambulance transport. This also correlates with the 10 STEMI cases identified pre transport by Milpitas personnel in the latter half of 2011. All respondents had medical access to STEMI care centers. This information supports data outlined by Levis that STEMI care center transports are essential to long term positive prognosis for the cardiac patient (Levis, 2010). The Levis study was specific to Santa Clara County but this information could be applied to agencies outside of the geographic area of Milpitas.

Discussion

The purpose of this applied research project was to examine the care provided by the MFD to patients whom present with signs and symptoms of the significant cardiac complaint of STEMI and to further apply industry best practices to the care provided by Milpitas firefighter paramedics. Non-scientific observations and reports would indicate that the levels of care being provided were consistent with core treatment recommendations, but no validation of care had taken place to either prove or disprove this assumption.
As previously outlined in the literature review, interviews, and industry questionnaire, the core benchmarks of best practices for STEMI care are accurate, early identification of the STEMI patient, coupled with appropriate treatment and transport. A discussion of the data collected in this research project has been divided into the following categories: rapid response, accurate identification, appropriate treatment, and transport. A comparison of Milpitas data to the core benchmarks referenced in AHA and NHTSA recommendations allowed for the verification and evaluation of current practices within the MFD.

Response times to emergency medical events were demonstrated as a key indicator of compliance with best practices for STEMI care. As indicated in the NFPA 1710 recommendations for response times to the EMS incident, MFD data supports paramedic arrival within an average on-scene time of four minutes and 39 seconds. This would validate early access to first-responder ALS as an evaluative diagnostic tool STEMI identification under NFPA 1710.

Rapid response was further validated in Studek’s article entitled “Association Between Prehospital Time Intervals and ST-Elevation Myocardial Infarction System Performance. “The article defined the following prehospital time intervals for STEMI care: ambulance arrival times of ≤10 minutes, ambulance on-scene time to 12-lead ECG acquisition ≤8 minutes, and ambulance total on-scene time of ≤15 minutes. With average response times in Milpitas for ALS first-responder care within the range of four minutes, these key time intervals can be greatly accelerated, thus delivering an improvement in long-term patient care. More importantly the average time for application of 12-lead ECG was 7.7 minutes in Milpitas. This is below AHA guidelines and would indicate that rapid
response of first responder ALS units would aid in early identification of STEMI patients in Milpitas. This was further validated by Zygowics in his performance indicator discussion that decreasing STEMI identification and transport times would aid in rapid reperfusion, thus equating to less cardiac damage, shorter rehabilitation time, and less medical expense.

As explained by O’Connor in the article “American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care,” accurate identification of the STEMI patient has been readily identified that “a strong Chain of Survival can improve chances of survival and recovery for victims of heart attack, stroke and other emergencies.” As emphasized by the AHA and further validated by analysis of report data, Milpitas paramedics evaluate all suspected cardiac chest pain patients via electronic monitoring and, therefore, can accurately determine STEMI criteria.

Further identification requirements can be validated via Santa Clara County EMSA field manual A08 (i.e., “Suspected Cardiac Ischemia). In this recommended treatment pathway, appropriate diagnostic testing is required and would determine the possibility of STEMI patient. The accurate identification of the STEMI patient will then not only allow for appropriate field treatment, but also appropriate hospital transport (SCCEMSA, 2009).

The data would suggest that appropriate treatment within STEMI criteria was consistent with Santa Clara County EMSA policy A08. Milpitas field treatment of the STEMI patient further meets criteria per AHA and NHTSA guidelines; however, other non-STEMI chest pain patients within the system may require additional reinforcement of care practices. With a compliance ratio of 87% for 12-lead application, the paramedics
within the system would appear to require additional reinforcement in this area of
treatment or documentation.

The final point of discussion is the appropriate transport of the suspected STEMI
patient to a STEMI receiving facility. Ultimately, definitive care will be delivered in a
hospital facility that is prepared to treat the STEMI patient. As outlined in Santa Clara
County policy 408, “STEMI Center Receiving Facility Standards,” mandates for specific
care facilities have been outlined to maximize the potential benefits for the STEMI
patient.

The organization impact associated with the collection and analysis of these data
points has brought awareness to these key areas of patient treatment in the STEMI
scenario. Further improvement in paramedic training and awareness and enhanced
mechanisms for data collection has been brought to awareness level of key stakeholders
within the organization.

Recommendations

Upon completion of this research project, several recommendations were
developed to improve cardiac STEMI care within the MFD. STEMI care enhancement
should include not only the actual patient care provided, but also the mechanism for data
collection and performance measurement of STEMI care within the MFD. This
performance measurement must be relayed through the chain of command in order to
validate that the improvements in STEMI patient care should include:

- Annual review of STEMI care policy.
- Scenario based training with ALS company STEMI identification.
- Reinforcement of NHTSA recommendations for aspirin administration.
• Enhancement of EMT/BLS personnel into STEMI chain of survival.
• Explore possible action research project to transmit ECG information to the receiving STEMI facility.
• Recognize outstanding patient care that truly makes a difference with STEMI outcomes.

Improvements to STEMI data collection and performance measurement:
• Embrace upcoming improvements in RMS.
• Develop a quarterly review program with a STEMI manager at local receiving facility with reverse STEMI retrieval from hospital to field setting.
• Implement field telemetry to the hospital from the ALS engine company.
• Mandatory review of all cardiac chest pain calls for service.
• Improve lines of communication between field providers and hospital specialists.

Recommendations for further discussion within the quarterly paramedic meetings were also recommended in order to exchange further information from the receiving facilities. Attendance by all stakeholders, including the agency’s medical director and EMS battalion chief, would be essential in order to emphasize the importance of rapid accurate identification of STEMI patients, coupled with appropriate treatment and transport.

These meetings should be utilized to evaluate and further improve STEMI care. These quarterly discussions are the intangible for Attendance by all stakeholders including the agency Medical Director and EMS Battalion Chief would be essential in
order to emphasize the importance of rapid accurate identification of STEMI patients coupled with appropriate treatment and transport. These meetings should be utilized to evaluate and further improve STEMI care by reinforcing rapid, accurate STEMI identification followed by appropriate treatment and transport.

In conclusion, the researcher has found this process to be a rewarding introduction into the forays of scientific research that can either prove or disprove an industry assumption that may have been applied to the reader’s agency without validation. More importantly, the researcher believes that the reinforcement of data collection cannot be underemphasized to the line firefighter. Without valid information, performance cannot be measured. In these times of increasing scrutiny for the services that we deliver, validation and proof must be provided for the cost of services. I support further research in the validation EMS services provided by fire service agencies.
References


Appendix A

STEMI Results Research NHTSA Performance Benchmarks

Total number of records reviewed 61
Exclusions 8
Number of records studied (n) 53
Number of identified STEMI patients 10
Mean age of STEMI patients 54 years
Mean time from 1st patient contact until first 12-lead EKG 7.7 minutes
Percent of STEMI patients who received ASA 100%
Percent of STEMI alerts called by MLP that met the criteria 100%
Percent of cardiac chest pain protocol patients receiving ASA 91%
Percent of patients that received two 12 lead-EKGs for comparison 87%
Percent of patients transported to a coronary intervention facility 100%
Appendix B

Departmental Interviews

1. What is your current title and role within the Milpitas Fire Department?

2. How long have you been a part of this organization?

3. What are the advantages or disadvantages to ALS first responder capabilities?

4. What are your priorities for STEMI care and evaluation or STEMI care?

5. What improvements can be made to STEMI care in Milpitas?
Appendix C

Fire Department Prehospital Cardiac Care Questionnaire

1. What is the population of the area that your agency serves?

2. How many fire stations are staffed within your agency?

3. How many calls for emergency medical care does your agency respond to within an average calendar year?

4. Do you provide advanced life support services within your agency via the engine based service model?

5. Does your agency provide ambulance transport?

6. What is the average response time for fire based advanced life support to arrive on scene in your agency?

7. How many cardiac (STEMI) patients are treated and identified by your agency over the course of an average calendar year?

8. What percentage on average of those STEMI patients treated by your agency receives 100% compliance with local protocols for patient care?

9. What percentage of STEMI patients on average within your agency are identified by prehospital fire service personnel prior to transport?

10. Have STEMI treatment centers been implemented within your local region?
Appendix D

Fire Department Prehospital Cardiac Care Questionnaire Results

1. What is the population of the area that your agency serves?

15,000 or less
15,000 to 50,000
50,000 to 100,000
100,000 to 200,000
200,000 or more

20%
50%
30%

2. How many fire stations are staffed within your agency?

1 to 5
5 to 10
10 to 50
50 or more

30%
40%
30%

3. How many calls for emergency medical care does your agency respond to within an average calendar year?

1,000 or less
1,000 to 5,000
5,000 to 10,000
10,000 to 100,000
100,000 or more

20%
40%
40%

4. Do you provide advanced life support services within your agency via the engine based service model?

Yes
No

90%
10%

5. Does your agency provide ambulance transport?

Yes
No

40%
60%

6. What is the average response time for fire based advanced life support to arrive on scene in your agency?

Under 4 minutes
4 to 6 minutes
6 to 10 minutes
Over 10 minutes

10%
80%
10%
7. How many cardiac (STEMI) patients are treated and identified by your agency over the course of an average calendar year?

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8. What percentage on average of those STEMI patients treated by your agency receive 100% compliance with local protocols for patient care?

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<td>90% to 100% compliance</td>
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9. What percentage of STEMI patients on average within your agency are identified by prehospital fire service personnel prior to transport?

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<td>60%</td>
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<tr>
<td>90% to 100% identified</td>
<td>30%</td>
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10. Have STEMI treatment centers been implemented within your local region?

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<th>Answer</th>
<th>Percentage</th>
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