

Evaluating the Effectiveness of Emergency Medical Response

by the City of Dalton Fire Department

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Appendices Not Included. Please visit the Learning Resource Center on the Web at <http://www.lrc.dhs.gov/> to learn how to obtain this report in its entirety through Interlibrary Loan.

CERTIFICATION STATEMENT

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Abstract

On November 1, 2010, the City of Dalton Fire Department (DFD) adopted a new emergency medical response protocol that significantly increased the number and type of emergency medical service (EMS) calls answered by the department. The problem was the effectiveness of DFD's newly adopted emergency medical response initiative was largely unknown. The purpose of this research was to determine the effectiveness of emergency medical response during the first 6 months under the new protocol. Evaluative research methodology was used to answer the following questions: (a) What impact has increased call volume had on operating costs for emergency medical response? (b) How are arrival times being impacted by DFD's emergency medical response initiative? (c) What services are being rendered to patients prior to the arrival of emergency medical services? (d) How has emergency medical response by DFD influenced patient outcomes? Procedures for research included analyses of department records, dispatch records, and EMS reports to provide specific answers to each research question. The effectiveness of DFD's new EMS response protocol was evaluated from three perspectives: monetary cost of service provision, changes in arrival times to patients, and possible improvements in patient outcomes as a result of fire department response. Based on the results of this study, DFD's newly adopted EMS initiative was deemed effective. Consequently, a recommendation was made to continue operations under the new response protocol with the caveat that services could be expanded in the future.

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Evaluating the Effectiveness of Emergency Medical Response by the City of Dalton Fire Department

The role of the American fire service in the provision of emergency medical services (EMS) continues to gain prominence in the modern era. In fact, over 85 percent of fire departments in the United States provide some level of emergency medical care to the citizens they serve (Janing & Sachs, 2003). In contrast to this statistic, the City of Dalton Fire Department (DFD) has traditionally had an extremely limited response protocol for emergency medical calls. On November 1, 2010, DFD adopted a new emergency medical response protocol that significantly increased the number and type of EMS calls answered by the department. The problem is the effectiveness of DFD's newly adopted emergency medical response initiative is largely unknown.

The purpose of this research is to determine the effectiveness of emergency medical response by DFD. The following four research questions will be answered during the course of this project: (a) What impact has increased call volume had on operating costs for emergency medical response? (b) How are arrival times being impacted by DFD's emergency medical response initiative? (c) What services are being rendered to patients prior to the arrival of emergency medical services? (d) How has emergency medical response by DFD influenced patient outcomes? The evaluative research method will be employed in compiling data for this applied research project. In summary, the aforementioned research approach will determine the effectiveness of DFD's emergency medical response initiative from 3 perspectives: monetary cost of service provision, expedience of service delivery to patients, and possible changes in patient outcomes as a result of fire department response.

Background and Significance

Since its inception in 1888, DFD has been an all paid professional emergency service provider. At present, DFD holds a Class II rating with the Insurance Services Office (ISO) and delivers services from 5 fire stations positioned strategically across the city's 21 square mile footprint (City of Dalton, Georgia, 2011). Emergency response activities are carried out through the use of 5 engines, 2 ladder trucks, 1 heavy rescue, and 1 incident command vehicle. There are approximately 30 personnel assigned to each shift within the suppression division. An additional 6 personnel are assigned to training, fire prevention, and administration. The department's operating budget for FY 2010 totaled \$7,035,345.00 (City of Dalton, Georgia, 2011).

As discussed in the National Fire Academy's Executive Development course, change management is a critical aspect of effective leadership. A key element of change management is the leader's ability to recognize the difference between what Heifetz and Linsky (2002) refer to as technical problems and adaptive challenges. Technical problems are those that are commonly faced and can easily be solved by utilizing existing resources. Conversely, adaptive challenges are not easily solved and typically require a paradigm shift within the organization and/or its constituents (Heifetz and Linsky, 2002).

One of the most prominent adaptive challenges currently facing DFD is the transition to EMS response. Although this may seem like a technical problem on the surface, it has proved to be much more complex than a mere change in policy. Historically, DFD has had a very narrow response protocol for EMS calls. Prior to November 2010, DFD only responded to motor vehicle accidents (MVAs) with possible entrapment or those involving pedestrians, bicycles, motorcycles, or trains. Additional call types that met DFD's response criteria included industrial accidents or entrapments, electrocutions, and patients in full arrest. DFD did not respond on any

other medical emergencies unless EMS had an extended delay (Whitfield County 911 Communications Center, 2010). A new EMS response protocol was adopted on November 1, 2010, resulting in significant expansion in the types of EMS calls answered by DFD. In addition to the aforementioned incident types, the department now responds to all medical calls that require an emergency response by EMS. Some examples include chest pains, difficulty breathing, seizures, diabetic emergencies, strokes, and traumatic injuries (Whitfield County 911 Communications Center, 2010). Since its adoption, the new protocol has resulted in a significant increase in call volume for DFD.

Prior to the adoption of the new response protocol, many members within DFD felt the taxpayers of Whitfield County were receiving a better value for their dollar than their city counterparts. This idea stemmed from the fact that Whitfield County Fire Department (WCFD) was far more likely to respond to a medical emergency than DFD. This issue was compounded by automatic aid agreements between DFD and WCFD which resulted in all county properties within a 1 mile radius of a city fire station being double served. To make matters worse, the millage rate in Whitfield County is much lower than that of the City of Dalton. For these reasons, many DFD personnel believed county residents and businesses were paying less and getting more from a customer service perspective. Frustration mounted when these individuals came to the realization that DFD's larger budget, better equipment, and more advanced training were of no use if those resources were not brought to bear when the taxpayer was in need.

Following the change in protocol, the drastic increase in emergency responses has come as a culture shock to some senior members of the department. Many of these personnel have gone their entire careers without call volume interrupting support activities that have become organizational priorities in the absence of emergency responses. As a result, a culture has

developed within the department that seems to place more emphasis on support functions than actually answering the calls that justify the existence of an all paid professional fire service.

Conversely, many line personnel (especially younger firefighters) love the increased call volume because it allows them to get out and perform the job they signed on for instead of being trapped in the fire station.

On a much larger scale, the current economic climate has forced many municipalities to reevaluate expenditures to ensure maximum efficiency and effectiveness. This has become a source of some concern among DFD's executive level leadership. Many within the department's administration feel some elected officials view DFD as a liability due to its lack of revenue generation. Consequently, there is an ongoing initiative to justify the department's operations and the expenses associated with service provision.

Delivering additional services in an attempt to strengthen public support for DFD weighed heavily in the decision to modify the emergency medical response protocol. Decision makers knew these changes would result in increased call volume, therefore increasing the department's visibility to the citizens it serves. In addition, administrators hoped the change in protocol would convey the department's progressive organizational philosophy and willingness to increase the level of customer service provided to citizens. It was equally important for DFD's incumbent personnel to understand that these changes were made in an effort to benefit not only the public, but the department and its members as well.

The overarching goal of this research is to determine if this policy change will be beneficial to DFD and the City of Dalton in the long term. Overcoming obstacles to progress and improving service to taxpayers will require a paradigm shift within DFD. If this transition is successful, taxpayers within the city should receive an exponential increase in value from their fire

department. In addition, the department is more closely aligning itself with the initiatives listed in the United States Fire Administration (2010) *Strategic Plan Fiscal Years 2010-2014*. The provision of additional services through EMS response has a direct correlation to the USFA goal to “reduce risk at the local level through prevention and mitigation” (USFA, 2010, p. 13).

Literature Review

The intent of an effective EMS system is to deliver comprehensive pre-hospital care and transportation services to patients in need (Janing & Sachs, 2003). The American fire service began playing an integral role in this system as early as the 1920s (Page, 2002). Although resisted by many fire departments until the 1960s, response to EMS incidents has grown to encompass a significant percentage of overall call volume in today’s fire service. There are currently 3 levels of emergency medical service delivery among fire departments. The most basic of these is the provision of basic life support (BLS) through first response activities. In some departments, firefighters are trained as paramedics who offer advanced life support (ALS) care to patients (Dean & Messoline, 2011). In both of these situations, a third party ambulance provides ongoing care and transportation to healthcare facilities. The third level of service is fire-based EMS. In these systems, the fire department operates all aspects of EMS including the provision of ambulance services (Freeman, 2002).

Advances in medical sciences and healthcare technology have resulted in continual changes in pre-hospital care. As the EMS system continues to evolve, so too does the fire service’s involvement in the provision of emergency medical services (Pratt, Pepe, Katz, & Persse, 2007). These constantly changing roles of the modern fire service have resulted in the development of two distinct schools of thought relative to medical response. The traditional perspective of some officers and firefighters adheres strictly to the idea that the fire department exists to provide fire

suppression and rescue services to the public. These people view response to EMS calls and provision of medical care as falling outside the scope and practice of the fire service (Roberts, 2011). A second perspective offers a more progressive, customer-based approach to emergency services. This perspective views EMS as an integral part of the overall mission of the modern fire service rather than a distraction from that mission (International Association of Firefighters, 2009). Proponents of this mindset encourage broadening departmental foci and diversification of services as methods of justifying the expense associated with funding professional fire and emergency service organizations (Bennett & Forsman, 2003, Hyden, 2011, Pouget, 2011). According to Heifetz and Linsky (2002), people are much more likely to make sacrifices (e.g. tax increases to fund emergency services) if the benefits of those sacrifices are made abundantly clear.

In keeping with the aforementioned perspectives on EMS in the fire service, several advantages have been noted regarding fire department involvement in the EMS system. Barakey (2010) lists training opportunities and public relations as the primary benefactors of increased call volume generated through EMS response. Increased opportunities for driver development, territory familiarization, apparatus placement, and building size-up are all mentioned as training that can occur during response to EMS incidents. Crawford (2010) echoes this sentiment through his belief that busier fire companies are far more likely to maintain proficiency, regardless of incident type. As fire volume continues to decline in response to increases in prevention initiatives, added call volume through EMS response can assist in generating the needed statistics for executive level leaders to justify their budgets (Ludwig, 2009).

The principal disadvantage of fire service involvement in the EMS system is the financial burden it creates (Dean & Messoline, 2011, Janing & Sachs, 2003, Page, 2002). Increased call

volume, coverage issues while units are tied up on medical responses, and added risk and liability are additional concerns regarding the downside of EMS response (Vadala, 2003). This notion has continued to garner the attention of elected officials as a result of current economic conditions. According to Hoene and Pagano (2010), continually declining tax revenues in 2010 resulted in an inability to meet fiscal needs in almost 90 percent of American cities. This has forced many municipalities to reevaluate efficiency and cost effectiveness in public safety spending. Consequently, fire protection services have been placed under the microscope as the target of widespread budget cuts (Walters, 2011a). This is especially true for programs viewed as extraneous by elected officials and financial decision makers.

In contrast to the above viewpoints on added fiscal liability, there are numerous arguments that oppose the implication that EMS response creates a drain on fire department budgets. Many view EMS response as an integral part of the core mission of today's fire service and believe the benefits far outweigh the marginal costs to fire departments and their stakeholders (Dean & Messoline, 2011, International Association of Firefighters, 2009, Wilmoth, 2011). The multi-role functionality of modern fire departments frequently allows the provision of additional services with little to no impact to taxpayers. While labor remains the most expensive facet of the EMS system, firefighters are already being compensated while on duty and are allowed to work more hours before being paid overtime than third party providers (International Association of Firefighters, 2009). In addition, apparatus, equipment, and facilities are already being paid for as well, thus utilizing them for EMS response allows more value for the tax dollar (International Association of Firefighters, 2009). This ability to serve stakeholders in a variety of ways is an extremely cost effective way to enrich services and garner public support (Hyden, 2011, Ludwig, 2009, Williams, 2001, Wilmoth, 2011). It is paramount that fire department personnel develop a

thorough understanding of the relationships that must be developed within the community to solidify support for their chosen profession (Walters, 2011b).

A review of applied research projects submitted to the National Fire Academy revealed numerous innovative solutions for increasing cost effectiveness in EMS response. The Arlington, Texas fire department initiated a training program that increased the medical certification levels of firefighters within the department (Brawner, 2003). Consequently, responding fire companies were able to deliver ALS care to patients more quickly than third party ambulance services. A similar initiative was instituted in Warrensburg, Missouri following a survey of stakeholder opinion on EMS care (Correia, 2003). In Warrensburg, citizens valued rapid response by well trained personnel capable of delivering high quality care to patients. By developing a public education program for EMS response and instituting a quality control program for EMS calls, the Warrensburg Fire Department was able to realize exponential increases in public support and service quality for minimal marginal cost (Correia, 2003). Each of the aforementioned perspectives on cost effectiveness, fiscal impacts, and marginal costs of added services could aid fire department leaders in making informed decisions regarding EMS response in the future.

Several initiatives in today's fire service are focused on transitioning toward a culture of customer service. As a result, much emphasis has been placed on delivering quality service to stakeholders in the most expedient manner possible. Many believe fire department response to EMS incidents is one way to accomplish that mission. Due to its strategic positioning within the community, the fire service has the unique ability to deliver services more rapidly (on average) than third party EMS providers (Dean & Messoline, 2011, International Association of Firefighters, 2009, Pratt et al., 2007).

Numerous fire departments throughout the United States have found EMS response to be a viable avenue for decreasing wait times for stakeholders and enhancing service quality. Gwinnett County, Georgia was able to significantly reduce response time to EMS incidents by increasing BLS coverage (Chadwick, 2007). By placing additional units in service, the gap between 911 call placement and the arrival of medically trained personnel was significantly reduced, thus bolstering public support for fire service involvement in EMS response (Chadwick, 2007). Similar improvements were accomplished in Lakewood, Colorado. The Lakewood Fire Department conducted a study to determine what public expectations were regarding EMS response times (Fey, 2010). Findings from the study resulted in several policy changes relative to EMS response and the development of a public education program that delineated all aspects of the department's protocols for EMS incidents. These efforts resulted in improved communication between the department and the citizens it serves, as well as higher levels of customer satisfaction among the populace (Fey, 2010). Citizens of Neenah, Wisconsin have also reaped benefits of EMS response by their fire department (Vander Wyst, 1998). Following the implementation of a first response program by Neenah Fire Department, citizens experienced a significant reduction in response time for medical emergencies (Vander Wyst, 1998). The importance of increased public support as a result of more expedient service delivery on EMS calls could be an invaluable bargaining tool in the future.

Medical treatments and emergency services rendered by fire department personnel at EMS incidents have increased exponentially over the last quarter century (Jacobson, 2011). Advances in medical training and pre-hospital emergency medicine have resulted in more comprehensive care for patients in the field (Pratt, Pepe, Katz, & Persse, 2007). In many areas, fire departments offer comparable levels of care to those provided by third party ambulance services (Page, 2002).

The administration of oxygen through advanced airway adjuncts and provision of intravenous fluid therapy are two examples of BLS services provided by many of today's fire departments. These capabilities allow fire service personnel to deliver treatment to patients regardless of their location or predicament. Through fire department response, treatment of injury or illness begins immediately upon arrival and is often administered before the patient is freed from entrapment or entanglement (International Association of Firefighters, 2009).

A review of applied research projects identified training and levels of certification to be a determining factor in service delivery to stakeholders. Through his research on medical licensing and staffing requirements, Foster (2001) determined an ALS response package with 1 paramedic and 1 EMT-intermediate was the best solution for Gwinnett County, Georgia Fire Department. This recommendation gave Gwinnett County the best chance of aligning itself with national standards for medical response and service provision (Foster, 2001). To enhance efficiency and continuity in medical training, Van Sparrentak (2004) recommended the Walled Lake, Michigan Fire Department create an EMS coordinator position within the department. Medical program research, quality assurance for EMS incidents, and the identification and forecasting of departmental needs relative to medical response were additional responsibilities outlined for the position (Van Sparrentak, 2004).

With regard to training, there are some that see fire service involvement in the EMS system as a weak link in the standard of care provided to patients. The medical community is often critical of EMS in the fire service due to the amount of training needed to keep pace with a constantly evolving, highly technical field (Dean & Messoline, 2011). These critics view firefighters with a "jack of all trades, master of none" attitude and are skeptical of their medical proficiency given the multitude of specialties the fire service is tasked with (Dean & Messoline, 2011).

Researchers have identified transfers in patient care from one provider to another as the most likely time for treatment errors and omissions to occur (Pratt, Pepe, Katz, & Persse, 2007).

“Such circumstances require that the fire service regularly exercise the leadership needed to ensure that integration of the parts of the prehospital emergency care system are coordinated well, with maximum benefit to the patient and minimum risk to the community” (Pratt et al., 2007, p. 10). All aspects of the EMS system (including the citizens it serves) could benefit greatly if fire departments align themselves with this ideology.

Another important aspect of evaluating effectiveness in EMS response entails an examination of how fire department involvement has influenced patient outcomes. The majority of communities have some level of appreciation for public safety, but few ever have to call upon these resources in an emergency. That said, it is imperative that fire departments know how their efforts have impacted the citizens they serve. Most departments rely on statistical analysis to measure their efforts against national standards, but statistics alone do not always provide decision makers with sufficient information. To gain additional perspective on public perception and customer satisfaction, a study was conducted within Livonia Fire & Rescue in Livonia, Michigan (Brandemihl, 2001). The intent of the study was to complete a self-evaluation of the fire department to determine how well it was meeting the needs and expectations of citizenry. Results from the study revealed information sharing between public safety entities and stakeholders is paramount in developing a thorough understanding among citizens of the capabilities and services offered (Brandemihl, 2001). Following the implementation of their first responder program, the Neenah, Wisconsin Fire Department instituted a public education program that promoted training for the lay public on the use of automatic external defibrillators (AEDs) in conjunction with CPR. The success of the program resulted in stakeholder demand

for placement of AEDs in public areas (Vander Wyst, 1998). The availability of these devices plays a significant role in improving the chances for a positive patient outcome from a cardiac event. In keeping with these tenets, the fire service is positioned to make significant impacts on patient outcomes as an integral contributor within the local EMS system.

In summary, the intent of this review was to provide the reader with an overview of fire service involvement in the EMS system. To accomplish this goal, a comprehensive review of relevant literature for each of the project's four research questions was completed. The reader should now possess a more thorough understanding of the budgetary issues associated with EMS response and the ideologies that influence financial decision making. Decreased response times and enhanced service delivery through BLS and ALS care were also reviewed to enrich the reader's knowledge of the subject matter. Finally, the impacts of EMS response initiatives were explored in an effort to illustrate the benefits of response for the patient as well as the responding organization.

Procedures

The research process was initiated with a brainstorming session to identify a topic of concern within DFD. Once a specific topic was chosen, a problem statement was developed that clearly identified the issue. A purpose statement and four research questions were then drafted to address the exact intent of the research project. Following an analysis of the purpose statement and research questions, the evaluative research method was identified as the most appropriate approach to exploring the specified problem. A comprehensive literature review was conducted to gain a broader perspective on EMS response in the modern fire service.

The overarching theme of the project was to evaluate the effectiveness of a newly adopted emergency medical response protocol within DFD. As a result, the first six months of operation

under the new response protocol were chosen for evaluation. The dates for this time period were November 1, 2010 through April 30, 2011. To establish a baseline for research, an identical six month period under the previous response protocol was selected for comparison. The dates for the control period were November 1, 2009 through April 30, 2010. Firehouse Software version 7.8.9 records management system was used to generate an incident type report summary for EMS responses during both time periods. These summaries included all responses within the National Fire Incident Reporting System (NFIRS) category entitled rescue and emergency medical service incidents. Some limitations were noted and are as follows: patient lift assists, motor vehicle accidents with no injuries, persons trapped in stalled elevators, and other non-emergent responses could not be filtered from the data set. Consequently, average response times and the percentage of positive patient outcomes could be slightly skewed due to the inclusion of these non-emergent responses.

To address the first research question, a list of all costs that could increase as a result of higher call volume was identified. The researcher coordinated with the Fire Chief's administrative assistant and the city finance department to identify and electronically query these marginal costs. The city currently uses Tyler Technologies' Munis Software for all accounting activities. Munis and Firehouse Software version 7.8.9 were used to generate reports on vehicle maintenance, tire purchases, and any other apparatus related expenses for the two six month periods. Maintenance costs were totaled for each period and compared to reveal any differences in apparatus maintenance costs. Due to the volatility of oil prices, fuel was calculated in terms of gallons consumed by emergency response vehicles. An average fuel price per gallon for each period was then established by averaging the monthly per gallon prices. Fuel for all DFD

vehicles is distributed by the city's public works department. Therefore, all fuel data was collected through inter-departmental invoicing.

Firehouse Software version 7.8.9 was used to query fire service injuries sustained on EMS calls for the same time periods. Additionally, all supplemental accident reports (for minor or untreated injuries not filed under worker's compensation) submitted during the two six month periods were reviewed in an effort to identify any increase in injuries associated with response to EMS incidents.

It should be noted that DFD does not pay for medical supplies or consumables used on emergency medical incidents. These items are provided through a pre-existing contractual agreement between the City of Dalton, Whitfield County, and Hamilton Emergency Medical Services (HEMS). The primary limitation of the research on higher marginal cost as a result of increased EMS call volume is the length of the time period being evaluated. Other limitations include possible inaccuracies in documenting associated costs in Firehouse Software records management system and unforeseen maintenance expenses that are unrelated to call volume.

The second research question sought to determine whether or not response by DFD would result in a decrease in average arrival times to patients. Put another way, is the customer being served more rapidly through fire department involvement? To answer this question, Firehouse Software version 7.8.9 was used to query average response time by incident type. This report provided the researcher with average response times for each subcategory within rescue and emergency medical incidents as well as an overall average for all rescue and EMS calls. Response time data was also obtained from Whitfield County 911 Communications Center. This effort utilized InterAct computer aided dispatch (CAD) software in generating arrival time data for DFD and HEMS. By comparing DFD's average response time to that of HEMS, any changes

in rapidity of service delivery to patients could be noted. Limitations that could affect accurate reporting of response times include delays in notification to units in the field, failure of fire or EMS units in notifying dispatch when responding or arriving on scene, or delays in entering response information into CAD software.

Specific services rendered and medical treatment provided by fire department personnel prior to the arrival of EMS was the focus of the third research question. This information was gleaned by the researcher reviewing individual incident narratives in Firehouse Software version 7.8.9 for all EMS responses during the time periods in question. In doing so, the specific services and treatments for each patient were determined and quantified. These figures were subsequently tallied and expressed in terms of frequency and as a percentage of total EMS responses. Finally, the statistics from each time period were subjected to comparative analyses to determine what services DFD provided under the old versus the new medical response protocol. The amount of detail provided in incident narratives relative to patient care and treatment was the primary limitation of this research.

The fourth research question focused on patient outcomes as a result of fire department response. Data for this research was gathered through coordination with the clinical manager at HEMS, Hamilton Medical Center's Wellsoft emergency department information system, and a comprehensive review of all medical incident narratives in the Firehouse Software records management system. In addition, the researcher interviewed company officers and emergency medical technicians (EMTs) who had first-hand knowledge of these incidents. This effort provided a more thorough understanding of patient conditions and treatment in the pre-hospital environment. In determining pre-hospital save opportunities, the only incidents considered for analysis were those in which DFD was first to arrive and initiate resuscitative efforts. Inadequate

record keeping and poor recollection of events by responders could create limitations in this research.

Definition of Terms

Response time: the amount of time elapsed between notification of units in the field and their subsequent arrival on scene.

Pre-hospital save: successful resuscitation of a patient in the field followed by delivery of a viable patient to a hospital emergency department.

Results

The evaluative research method was employed in an effort to determine the effectiveness of DFD's newly adopted emergency medical response protocol. Prior to addressing the research questions, Firehouse Software queries for total EMS responses for both time periods were conducted to provide a baseline for the project. The number of EMS responses between November 1, 2009 and April 30, 2010 totaled 178. Under the new protocol, total EMS responses increased to 923. As shown in Figure 1, DFD's adoption of a new EMS response protocol resulted in a 519% increase in medical responses. In comparison, responses for all other incident types remained relatively constant with 413 responses during the control period and 456 since the change in protocol.

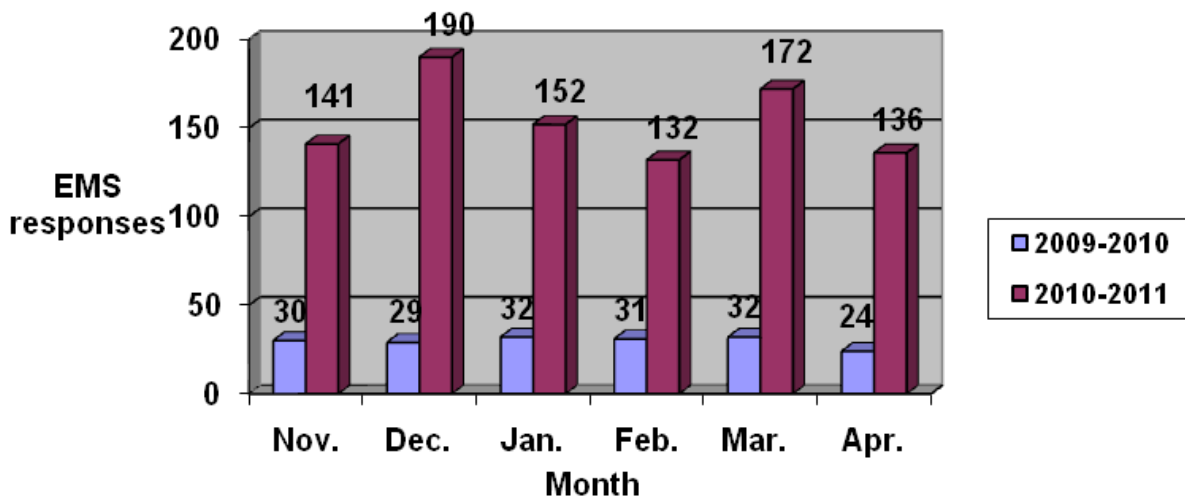


Figure 1. *DFD Medical Responses by Month*

The first research question asks: *What impact has increased call volume had on operating costs for emergency medical response?* This question was answered by identifying and totaling all marginal costs associated with an increased number of emergency medical responses. The primary variables identified for this study were changes in vehicle maintenance, fuel consumption, firefighter injuries as a result of response to EMS incidents, and consumption of medical supplies and equipment.

Total expenditures for vehicle maintenance was the first variable addressed. As shown in Appendix C, queries generated by Firehouse Software 7.8.9 revealed total vehicle maintenance expenditures of \$12,805.97 during the control period. Appendix D shows these expenditures increased to \$15,391.36 during the first six months under the new EMS response protocol. The resulting net increase in vehicle maintenance expenses totaled \$2,585.39.

The second variable analyzed in determining changes in marginal cost was fuel consumption. It is important to note that only diesel fuel consumed by first-line fire apparatus that regularly respond to EMS incidents was considered in this research. Through the use of Munis accounting

software and inter-departmental billing statements, it was determined that fuel consumption for first-line apparatus totaled 5401.10 gallons during 2009-2010. That figure jumped to 7430.69 gallons under the new response protocol, resulting in a net increase in fuel consumption of 2029.59 gallons. Constant volatility in the oil market prevented the determination of an exact price per gallon for diesel fuel during each time period. As a result, monthly fuel prices were used to provide an average fuel cost per gallon for each period. Table 1 illustrates the increase in marginal cost associated with higher fuel consumption rates. Changes in fuel consumption under the new protocol resulted in a net increase of \$8480.97 in fuel expenditures.

Table 1. *DFD Diesel Fuel Consumption by Month*

Month	Gallons	Total cost	Average price/gallon
<i>2009-2010</i>			
November	903.10	\$1,905.56	\$2.11
December	733.00	\$1,546.62	\$2.11
January	947.70	\$1,999.62	\$2.11
February	866.80	\$1,900.32	\$2.20
March	950.20	\$2,378.27	\$2.50
April	1000.30	\$2,593.66	\$2.59
Total	5401.10	\$12,324.05	\$2.27
<i>2010-2011</i>			
November	1155.20	\$2,859.12	\$2.48
December	1128.70	\$2,793.52	\$2.48
January	1188.90	\$3,133.78	\$2.47
February	1163.67	\$2,869.23	\$3.21
March	1358.30	\$4,364.92	\$3.21
April	1435.92	\$4,784.45	\$3.33
Total	7430.69	\$20,805.02	\$2.77

Costs incurred due to fire service injuries sustained as a result of response to EMS incidents were also evaluated. There was one reported injury during the control period on January 16, 2009 when a firefighter strained his lower back while lifting a stretcher. A similar injury occurred on December 27, 2010 when a firefighter slipped and fell on ice while assisting in the loading of a stretcher. Neither injury was treated by a medical professional, thus no worker's

compensation costs were incurred by DFD. Consequently, there was no change in frequency or total cost for this variable.

The final variable in the determination of marginal cost for increased EMS response was medical supplies and equipment. DFD does not pay for medical supplies or consumables used on emergency medical incidents. These items are provided through a pre-existing contractual agreement between the City of Dalton, Whitfield County, and Hamilton Emergency Medical Services (HEMS). As a result, no increase in medical equipment or supply costs was noted.

Following an analysis of all variables considered, a total figure for marginal cost associated with EMS response could be generated. This dollar amount was determined by adding the net change in vehicle maintenance expenditures (\$2,585.39) to the net change in fuel expenditures (\$8480.97) under the new protocol. All told, increases in the number of EMS responses by DFD resulted in an overall marginal cost of \$11,066.36. The marginal increase in total EMS responses was determined by subtracting the 178 incidents during 2009-2010 from the 923 incidents under the new protocol. This increase of 745 responses was then divided into the total marginal cost of \$11,066.36, resulting in an average marginal cost per response of \$14.85.

The second research question asks: *How are arrival times being impacted by DFD's emergency medical response initiative?* Appendices E and F illustrate Firehouse Software queries of DFD's average response time by incident type for the time periods in question. It is important to note that these queries only include responses to EMS incidents. During the 2009-2010 control period, DFD's average response time to EMS incidents was 4 minutes 52 seconds. When non-emergent responses (e.g. removal of victims from stalled elevators and Rescue/EMS stand-bys) were factored out, average response time was reduced to 4 minutes 14 seconds. Similarly, average response time under the new EMS response protocol was 4 minutes 58

seconds. The removal of non-emergent responses resulted in an average response time of 4 minutes 22 seconds.

Average response times for HEMS were also evaluated. To maintain continuity, only emergency responses within the City of Dalton were included in the analysis. Data was obtained through monthly reports generated by the clinical manager at HEMS.

Table 2. *HEMS Average Response Time by Month*

Month	Average Response Time	Month	Average Response Time
	<i>2009-2010</i>		<i>2010-2011</i>
November	4:47	November	3:32
December	5:04	December	4:25
January	4:05	January	5:14
February	4:16	February	4:27
March	4:22	March	4:40
April	4:25	April	4:35
Period Average	4:30		4:29

Source: Hamilton Emergency Medical Services

As illustrated in table 2, HEMS reported an average response time of 4 minutes 30 seconds during the control period. That average time dropped to 4 minutes 29 seconds during 2010-2011 while responding in conjunction with DFD.

Additional research was conducted through cooperation with Whitfield County 911 Communications Center. This study utilized InterAct CAD software to generate arrival times for DFD and HEMS for all emergency medical responses. It is important to note that non-emergent responses were removed from this study to maintain continuity between data sets. A total of 15 responses among the original 923 were disqualified (4 removal of victim from stalled elevators;

11 Rescue/EMS stand-bys). As a result, the final number of responses included in the study totaled 908.

Appendices G and H illustrate arrival times for DFD and HEMS. Of the 908 responses studied, 69 incidents resulted in DFD being cancelled en route, staged by law enforcement, or dispatched at the request of HEMS after their arrival. To prevent a skew in the data set, these responses were removed from arrival time analyses. Data from the remaining 839 responses revealed that DFD was first to arrive and provide services to patients in 612 instances (72.94%). Conversely, HEMS was the initial arriving entity on 227 responses (27.06%). The data also illustrated the average time elapsed between the arrival of DFD and HEMS. In the 612 cases where DFD was first on scene, the average elapsed time before HEMS arrived was 3 minutes 17 seconds. In contrast, HEMS had an average elapsed time of 1 minute 25 seconds on scene prior to DFD's arrival.

Research question three asks: *What services are being rendered to patients prior to the arrival of emergency medical services?* For calls where DFD was first to arrive, incident narratives were analyzed to determine what services and treatments were rendered by DFD personnel. Table 2 illustrates actions taken by DFD units on EMS incidents prior to the arrival of HEMS. It is important to note that the oxygen therapy and advanced airway categories refer to patients who were receiving oxygen or airway management in conjunction with another treatment type. Therefore, the numbers represented in these categories were not included in the totals.

Table 3. *Medical Treatment Rendered by DFD*

Treatment Rendered	2009-2010	2010-2011
Initial Assessment/Vitals	67	490
Oxygen Therapy	8	124
Trauma Care	24	93
CPR	4	15
Advanced Airway	0	5
Extrication	6	14

The fourth research question asks: *How has emergency medical response by DFD influenced patient outcomes?* In making this determination, data was obtained through HEMS patient care reports, DFD incident reports, and Hamilton Medical Center's Wellsoft emergency department records management system. Research was supplemented through discussions with company officers and EMTs who responded to each incident. All data collected was expressed as a ratio of save opportunities versus actual saves for both time periods.

During the 2009-2010 control period, DFD responded to 178 EMS incidents. Of those, there were 5 instances where DFD arrived first and had an opportunity to make a save through cardiopulmonary resuscitation (CPR). Unfortunately, none of these efforts were successful. Save opportunities represented 0.0281% of total EMS call volume and resulted in a 0% save rate.

Under the new EMS response protocol, DFD was presented with 16 save opportunities in 923 responses (0.0173%). Four of these 16 patients (25%) were successfully resuscitated and transported to Hamilton Medical Center via HEMS. In addition, one DFD crew successfully delivered an infant during a winter storm. The delivery stemmed from an inability of HEMS to

access the patient's residence. Once stabilized, mother and baby were transferred to HEMS for transport. There were no complications as a result of the delivery and both patients were released following an observation period at the hospital.

Discussion

The intent of this applied research project was to evaluate the effectiveness of DFD's newly adopted EMS response protocol. This was accomplished through analyses of marginal costs associated with increased call volume and changes in expedience of service delivery to stakeholders as a result of fire department response. In addition, the specific services rendered by DFD prior to HEMS arrival were explored. The final variable to be considered was the impact this change had on stakeholders in the City of Dalton. Changes in arrival times, services rendered, and patient outcomes were used to evaluate the marginal benefits of providing additional services.

Findings for the first research question showed an overall increase in marginal cost of \$11,066.36. When divided by the marginal increase in call volume (745), an average marginal cost per response of \$14.85 was determined. This minimal increase in cost confirms the idea that the most expensive parts of fire service involvement in the EMS system (manpower, apparatus, and facilities) are already paid for (International Association of Firefighters, 2009). Consequently, utilizing fire service resources to handle EMS incidents for no increase in budget gives additional value to the taxpayer's dollar (Crawford, 2010).

The importance of exhibiting value to taxpayers cannot be overstated in today's economic climate. The inclusion of EMS response in DFD's strategic plan and as a facet of the marketing strategy is closely aligned to the writings of Hyden (2011) and Walters (2011a) on cost effectiveness and the future of the fire service. These findings also support Ludwig's (2009)

belief that while saving money is vital in the public sector, it should not be given more importance than the safety of the public. A marginal increase of less than \$15 per call should make marketing EMS response as an added service by DFD a relatively simple task. Pouget (2011) suggests, “We must remember that the population we serve financially supports our service through our tax dollars, and we must work to educate ourselves – and every firefighter – on the importance of our roles as public safety advocates” (p. 44). If DFD could develop a public education program similar to those proposed by Correia (2003) and Walters (2011a), subsequent public support for additional services could increase significantly.

The decision by DFD to respond to EMS incidents without making any significant changes should be more cost effective than other options that involve financial outlay for higher levels of certification or advanced equipment. For example, the paramedic engine company concept discussed by Brawner (1999) would create significant training expenses for DFD. Similarly, fire-based EMS is not a viable option for DFD at present. As mentioned by Dean & Messoline (2011), such widespread expansion would prove cost prohibitive in the short term. The model adopted by DFD is more closely aligned with the BLS option proposed by Chadwick (2007) for implementation in Gwinnett County, Georgia and the first response program Vander Wyst (1998) recommended for Neenah, Wisconsin.

The researcher believes the net changes in costs identified in this research are a direct reflection of response to emergency incidents because the schedule of support activities was consistent during the time periods being evaluated. However, long-term costs associated with increased frequency of preventive maintenance, tire replacement, and overall vehicle serviceability cannot be accurately determined when evaluating a six month period of time. Increased hours compiled on apparatus due to higher call volume will eventually lead to more

frequent preventive maintenance activities, thus creating a rise in maintenance costs. The researcher feels the impact of these costs would be far more accurate when analyzed over a period of 5 to 10 years. Although there was an increase in marginal costs, the researcher feels the benefits gained far outweigh the expense of expanding services.

Results from response time analyses revealed several differences between DFD and HEMS. Average response time for emergency incidents was separated by an extremely narrow margin, with DFD arriving only 7 seconds more quickly than HEMS. Data generated by Whitfield County 911 Communications Center concluded DFD was first to arrive on 72.94% of EMS calls. For these incidents, the average time elapsed between initial patient contact by DFD and the arrival of HEMS was 3 minutes 17 seconds. In instances where HEMS was first to arrive, the time elapsed before DFD's arrival was 1 minute 25 seconds. These statistics are in keeping with the Pratt et al. (2007) thoughts on shorter response times contributing to streamlining in the modern EMS system. Dean & Messoline (2011) echo this sentiment in their discussion on limited resources of third party EMS providers. Due to the inherent, multi-role functionality of the fire service, rapid arrival of fire units often results in more comprehensive care for patients (Wilmoth, 2011). Additionally, delivering care more rapidly to patients greatly increases the chances for positive outcomes in medical and trauma patients (International Association of Firefighters, 2009).

The provision of services in a more timely manner during an emergency can serve as a marketing tool when dealing with stakeholders and elected officials. According to Walters (2011b), data generated through this type of research should speak for itself and be utilized by executive level leaders during budget hearings and justification of services. This notion is

supported by Pouget's (2011) discussion on clearly communicating needs to political leadership to ensure organizational success in the future.

The researcher believes the response time statistics dictate that DFD's new EMS protocol has been beneficial to stakeholders. Since its adoption, DFD has made first contact with patients in almost 73% of cases. If fire personnel can close the gap by providing medical care during that 3 minute window before HEMS arrives, the citizens of the City of Dalton are definitely being better served by their fire department. Moreover, the patient's chances for survival and recovery are exponentially increased through faster treatment.

As illustrated in the Results section, DFD is providing a multitude of treatments to patients encountered on EMS incidents. These services range in complexity from a simple bandage to CPR with advanced airway, oxygen therapy, and AED application. These treatments begin upon arrival and are often carried out prior to the patient being rescued or disentangled by firefighters (International Association of Firefighters, 2009). However, services rendered during an EMS response are not always medical treatments. Many incidents result in opportunities to promote public relations and educate stakeholders while in their homes or places of business. Barakey (2010) lists smoke detector checks or installations, fire safety inspections, and tips on cooking safety as methods in which firefighters can elevate the level of customer service provided during EMS responses. These practices are yet another way in which fire departments can align themselves with Hyden's (2011) marketing principles for public entities.

Prompt, efficient, and effective medical treatment drastically increases survivability among patients (Pratt, Pepe, Katz, & Persse, 2007). This concept is made obvious by statistics gathered through this applied research project. During the control period, DFD had 5 save opportunities in 178 EMS responses. None of these 5 were successful. Under the new EMS response protocol,

DFD was presented with 16 save opportunities in 923 responses (0.0173%). Four of these 16 patients (25%) were successfully resuscitated in the field before being transferred to the hospital. Although the percentage of save opportunities was lower under the new protocol, the researcher believes quicker arrival to the patient has resulted in a higher success rate in resuscitative efforts. Overall, the EMS response initiative has allowed DFD to make a positive impact on families, regardless of patient outcomes.

Recommendations

Data obtained through research indicates that the marginal benefits far outweigh the marginal costs for EMS response. Decreased response times have resulted in quicker service delivery to stakeholders and a subsequent increase in positive patient outcomes. For these reasons, the researcher believes DFD's newly adopted EMS response initiative has been effective during the first 6 months of operation.

In the short term, the researcher recommends a continuation of EMS response by DFD. Doing so would continue to strengthen relationships between DFD, HEMS, and the citizens served by both organizations. In addition, proficiency levels in emergency medical care should continue to improve among DFD personnel. As previously stated, the significant increase in total call volume that will result from EMS response can be utilized to justify programs and budgetary requirements in the future.

To gain more accurate results, a similar study should be conducted after DFD has operated under the new protocol for 5-6 years. If the current EMS response protocol is successful in the mid term, it could help pave the way for ALS service provision by DFD. Looking to the future, DFD could eventually become a successful fire-based EMS provider for the city and its inhabitants.

It is the researcher's hope that the findings of this applied research project will assist the executive leadership of DFD in justifying EMS response to citizens in the City of Dalton. In addition, this document will be made available to all DFD personnel, elected officials, HEMS administrators, and Whitfield County 911 command staff for review and discussion. If others wish to evaluate effectiveness of programs within their own organizations, the researcher believes this document may offer unique perspective and assist in the generation of ideas during the research process.

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