A STUDY TO DETERMINE IF PARAMEDIC ENGINE COMPANIES WOULD PROVIDE A MORE EFFICIENT LEVEL OF SERVICE FOR THE ALHAMBRA FIRE DEPARTMENT

ADVANCED LEADERSHIP ISSUES
IN EMERGENCY MEDICAL SERVICES

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An applied research project submitted to the National Fire Academy as part of the
Executive Development Course
April 1998

ABSTRACT

The increasing role of emergency medical services (EMS) in the Fire Service forces fire administrators to look at alternatives to providing these services.

The purpose of this research project was to establish if the Alhambra Fire Department could provide a more efficient and cost effective delivery of EMS through the implementation of Paramedic Engine Companies using existing resources. This would include maintaining ambulance transportation utilizing (non-sworn) Emergency Medical Technician - 1's (EMT-1's).

Evaluative and action research methodologies were used in this research to answer the following questions:

1. Is the Department efficiently and effectively utilizing its personnel resources?
2. Does the Department have resources in place to establish paramedic engine companies?
3. Does the Department meet its operational objective of providing equal levels of emergency medical services to all four fire station jurisdictions on an initial response basis?
4. Does historical data support the implementation of basic life support (BLS) ambulances?
5. Is research available to support the concept of paramedic engine companies?

An assessment was conducted on how the Department currently delivers emergency medical services. Fire Department resources were evaluated to establish if they were effectively utilized in an efficient manner. Historical data was analyzed to establish patient

populations based on call type and level of care provided. Literature was reviewed from a company that provides contract employees for two other fire departments in Southern California. Financial data was obtained and reviewed from the city finance department detailing the personnel cost of firefighter paramedics. Alhambra units response times were analyzed on an initial response for EMS calls.

The findings of the research support the concept of paramedic engine companies for the City of Alhambra, while implementing BLS ambulances staffed by EMT-1's, non-sworn employees. This, however, is predicated on further studies to address some operational concerns brought to light as a result of this study.

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INTRODUCTION

In order to accurately assess whether or not the department is efficiently utilizing its resources in the area of EMS, a patient population must be defined to accurately identify the two basic patient or call types, advanced life support (ALS) and basic life support (BLS) patients. This is done retrospectively utilizing data collected on patient run reports for the past four years. The Alhambra Fire Department uses a program provide to us by our local EMSA. The program is called LA EMS, and is designed by Lancet Technologies, a computer software company that specializes in emergency services data collection. The software is provided to the department free of charge.

The Alhambra Fire Department implemented an ALS service in 1988. This service is provided with two department ambulances staffed with two Firefighter paramedics. The program originally required the department to maintain a staffing level of 18 Firefighter paramedics. Due to promotions, the department now has 32 paramedics, 13 of which are at the ranks of captain or engineer. In addition, one Firefighter and two engineers are currently attending paramedic school.

Initially, the department responded to the surplus of paramedics by implementing two paramedic extension engines. Paramedic extension engines are equipped with limited ALS supplies and staffed with one paramedic to deliver limited advanced life support to a patient before the arrival of the paramedic ambulance. The extension engines do not carry medications. After a six-month trial period with the extension engines, the department implemented two paramedic assessment engines. Paramedic assessment engines are equipped and staffed the same as extension engines with the addition of first-

line cardiac medications, they also require staffing of at least one paramedic 100% of the time. Extension engines did not require the department to staff the engines with a paramedic 100% of the time, only when a paramedic was available.

With 35 paramedics on the department, a crossroads has been reached as to how to efficiently and effectively utilize its personnel resources. This coupled with the fact that through attrition, more Firefighter paramedics will be promoting to the ranks of engineer and captain in the future. Paramedics at the rank of engineer and captain are paid an incentive bonus of 5% for maintaining their paramedic licensure.

The purpose of this research project was to determine if the department could more efficiently and effectively utilize its personnel resources by changing its emergency medical services delivery model to the paramedic engine company concept and implementing BLS ambulances.

Evaluative and action research methodologies were used in this research to answer the following questions:

1. Is the Alhambra Fire Department efficiently and effectively utilizing its personnel resources?
2. Does the Alhambra Fire Department have resources in place to establish paramedic engine companies?
3. Does the Alhambra Fire Department meet its operational objective of providing an equal level of emergency medical services to all four fire station jurisdictions on an initial response basis?
4. Does historical data support the implementation of BLS ambulances?

5. Is there research available to support the concept of paramedic engine companies?

BACKGROUND & SIGNIFICANCE

The City of Alhambra is a charter law city with a council/mayor form of government. The city is located in Los Angeles County, California. The City encompasses 7.64 square miles and makes up part of the San Gabriel Valley. Alhambra is bordered on the west by Los Angeles City, on the east by the cities of San Gabriel and San Marino, on the north by South Pasadena and the south by Monterey Park.

The community has a population of approximately 85,000 people. The make-up of the community consist primarily of residential housing, a large retail area, and a small industrial area.

The Alhambra Fire Department has four fire stations that are geographically located in four equal parts of the city, creating four separate station jurisdictions. Station 1 houses and staffs one first-line engine company with three personnel, one first-line truck company with three personnel, one first-line paramedic ambulance with two personnel, one command vehicle staffed with one person, and one reserve truck. Total staffing at Station 1 per day is nine people. In addition, Station 1 consists of administrative personnel, including the fire chief, deputy chief, fire marshal, arson investigator, paramedic coordinator, two fire prevention specialists, and four secretarial personnel. Station 2 houses one first-line engine company staffed with three personnel and one reserve paramedic ambulance. Station 3 houses one first-line engine company staffed with three personnel and one reserve engine. Station 4 houses one first-line engine company staffed with three personnel and one paramedic engine company staffed with two personnel. Minimum daily staffing for the fire department is 20 personnel.

The level of emergency medical services the Alhambra Fire Department currently provides is at the ALS level supported by BLS. The department staffs two paramedic ambulances with two paramedics, two BLS engine companies staffed with EMT's, and two engine companies with limited ALS capabilities. These engine companies are staffed with at least one paramedic and two EMT's.

The department has had patient transport capabilities since 1927. Up until 1980, the department had provided emergency medical services with personnel trained to some level of first aid. After which, the department provided emergency medical services with personnel trained to the EMT-I level. In 1997, the Department started providing emergency medical services at the advance life support level utilizing personnel trained as paramedics, staffing both ambulances with two Firefighter paramedics.

In 1996, the department equipped Engines 2 and 3 with advance life support equipment and IV supplies, with the exception of medications. These engine companies were staffed with one paramedic regardless of rank and two EMT's to implement paramedic extension engines. Extension engines were able to provide limited advance life support care and treatment to patients until the arrival of a paramedic ambulance. This concept of extension engines did not require the department to staff these two engines with paramedics 100% of the time. However, after a six-month trial period, the department determined that they could staff these two units with at least one paramedic 100% of the time. This led to the decision to upgrade these two units to paramedic assessment engines.

In 1997, Engines 2 and 3 were upgraded to paramedic assessment engines. These

engines were equipped with first-line cardiac drugs and other medications, in addition to the equipment included on the extension engine inventory. The staffing required one paramedic 100% of the time, according to policies established by the Local Emergency Medical Authority (LEMSA). In contrast, the extension engines only required the department to staff the engine with a paramedic when one was available, without committing the unit to ALS capabilities 100% of the time. The paramedics that staffed the extension and paramedic engines were at the ranks of Firefighter, engineer, or captain, depending on the availability of personnel on duty on any given day.

The Alhambra Fire Department has had the luxury of increasing the number of paramedics on the department for the past few years. This in part, is due to the promotion of paramedics into the ranks of fire engineer and fire captain. Other contributing factors include the move to paramedic licensure within the State of California, along with the elimination of two-year testing and recertification. These last two factors have made it easier for promoted paramedics to maintain their licensure by completing 48 hours of continuing education every two years.

The concept of upgrading the Department's ALS capabilities to extension engines, and later to paramedic assessment engines was based on the idea of providing an equal level of service to all the citizens of Alhambra on an initial response basis. In addition, the department had the personnel resources available, due to the promotion of paramedics to the ranks of engineer and captains.

Currently, the department has a total of 32 paramedics with one Firefighter and two engineers attending paramedic school, which would bring the department's paramedics to

a compliment of 35. This would bring the number of paramedics on the department to a total almost equal to half the number of line personnel the department employs.

With the implementation of the two paramedic assessment engines at Station 2 and 3, and the deployment of two paramedic ambulances at Station 1 and 4, the department assures an equal level care on the initial response in all four station jurisdictions. Although response in Engines 2 and 3's district would be of limited advanced life support capabilities.

In 1987, when the department started providing emergency medical services at the ALS level, it needed to staff two paramedic ambulances with two paramedics. This required the department to maintain staffing level 18 paramedics at the Firefighter rank. While the department needed only 12 paramedics to staff the two ambulances, the additional six paramedics were used to cover paramedics on vacation, holidays, and sick days. This staffing level also allowed paramedics to rotate on the engines in order to prevent burnout.

Since 1993, the department has been entering all information collected on a patient run report on an EMS computer program provided to us by our local emergency medical services authority. This program has allowed us to analyze every aspect of our EMS delivery system. With four years of data available, the department can accurately analyze if they are efficiently and effectively utilizing their resources and delivering the highest level of emergency medical services.

The research conducted will have a significant operational impact on how the Alhambra Fire Department utilizes its personnel resources, as well as how the department provides

and delivers emergency medical services in the future. Fire administrators must continually analyze the way they conduct business in order to meet the ever changing demands put on them and their departments by policy makers, the public and their employees. Challenges from private EMS providers and pressures from managed care organizations, are having and will continue to have, an impact on how public providers (fire agencies) streamline their EMS delivery systems.

This research paper addresses issues identified in the Advanced Leadership Issues in EMS regarding emergency medical service delivery system and design, providing a cost effective and efficient service, and the transportation aspect of EMS.

LITERATURE REVIEW

The purpose of the literature review is to determine if paramedic engine companies established in other departments met the needs of their departments and their communities by becoming more cost effective and efficient in their delivery of emergency medical services.

James Fiero, Division Chief for the Austin Fire Department in Austin, Texas concluded in his applied research project for the National Fire Academy, that several benefits are gained in the implementation of paramedic engine companies which include, "more productive and effective use of emergency personnel, reduced number of total emergency workers required to provide consolidated services while enabling executives to enhance paramedic fire company manning levels, established rank and promotional structures for paramedics which reduces turnover rates, reduced operational cost (including: recruitment, training, maintenance and system management cost), improved team effectiveness, furnishes administrators with the capability to manage the problem of worker burnout and rust-out, decreased response time, and improved services to the community at lower cost than provided by separate systems" (James Fiero, 1990).

While these conclusions are consistent with other literature reviewed, not all the conclusions may be applicable to all departments. The improved team effectiveness certainly leads to the overall continuity of care provided to the patient. Worker burnout and rust-out can be alleviated by incorporating paramedics on engine companies as part of a crew by eliminating them from transporting BLS patients to the hospital, which requires more time. This factor alone will increase the productivity of those personnel and free them

up for ALS level calls that may come in during the transport of a BLS patient. The "dual role all-risk multi-function" (California Fire Service EMS Position Paper, 1994) of the fire service paramedic conforms to the paramedic engine company concept. By taking paramedics off the ambulances and front-loading the first response engine companies with the paramedics, thereby making them fully ALS capable, the workload that was carried by two units is now carried by four (Riley, 1988 and Butler, 1989). In addition, you are decreasing the workload in half again by not committing your ALS resources on BLS level transports to the hospital.

The Anaheim Fire Department in Anaheim, California has had similar success with the paramedic engine concept. The Anaheim Fire Department sights "an improved level of service, an increase in cost effectiveness, no need for additional work force, greater flexibility, and the alleviation of paramedic burnout" toward the implementation of paramedic engines. The City of Anaheim went from three paramedic units providing ALS level of care to five paramedic engine companies providing ALS service to the community at a reduced response time of three- to five-minutes 95% of the time (Simpson and Bowmen, 1983). Since this time, the Anaheim Fire Department has implemented three additional ALS engine companies.

Paramedic engine companies requires that two paramedics be assigned to the engine to function in the capacity of an ALS unit. By assigning, the paramedics that were on the ambulances to the engine companies, you have increased your staffing on the engine to four. When an EMS call is determined to be at the ALS level, one paramedic would be able to accompany the patient to the hospital in the BLS ambulance that is already

equipped with ALS equipment and supplies. This would allow the engine company to go back into service as an ALS assessment engine staffed with three personnel, one paramedic, and two EMT's. The paramedic that went to the hospital with the ambulance would be brought back to the station by the ambulance or respond to a subsequent call in the ambulance and join the engine company.

The Phoenix Fire Department has had great success using the paramedic engine company concept as well. They sight the cost effectiveness of their program along with their success in justifying staffing levels. Policy makers may find it difficult to allocate money to increase or maintain minimum staffing levels for fire suppression. However, they may be more inclined to allocate money to maintain staffing levels for a four person engine company needed to deliver care and treatment to the sick and injured. This is more readily justified by fire administrators simply by demonstrating a typical cardiac arrest scenario to the policy makers along with presenting statistics on the difference in call volume between fires and EMS calls (Morris, 1993).

While there has been a general decrease in the need for fire suppression personnel due to the decrease in fires over the years, the number of EMS responses have steadily increased (Thorp, 1993). This fact alone should prompt the fire administrator to look at alternatives to service delivery, such as the paramedic engine concept.

Justification of staffing levels is always at the forefront for today's fire administrators. Based on studies done by both the Anaheim, California and Dallas, Texas Fire Departments, the minimum personnel needed to effect successful fire ground operations is four firefighters on an engine company. This also holds true for EMS calls. A minimum of

four personnel are needed on scene for a medical emergency to "effectively administer medical treatment in a typical EMS scenario" in the prehospital setting. The American Medical Association (AMA) also supports the concept of at least four personnel, "at least two trained to the ALS level and two trained to the BLS level, are required to provide advanced cardiac life support (ACLS) to cardiac arrest victims" (Dittmar, 1993).

Currently, there is no funding mechanism in place for first responder reimbursement, regardless of the level of care provided, however, there is a funding mechanism in place for medical transportation services. These funds for transportation services help defer the cost of the services provided. The cost of providing ALS services through ALS ambulances staffed with Firefighter paramedics is quite high compared to staffing BLS ambulances with EMT level personnel. There are alternatives to providing transportation services without using dual-role multi-function fire service personnel. In order to maintain or secure the revenue generated from ambulance transportation, which helps pay the cost of the service, a fire department should maintain control of the transportation aspect of their system. This could be done utilizing non-sworn personnel that are trained at the EMT-1 level. A personnel company that pays the employee, provides for benefits, and maintains insurance coverage for the employees could supply these employees. This model is done successfully in Huntington Beach, California, as well as, La Habra, California. While both departments collect the revenue for the transportation aspect of their service, the cost of providing the service is substantially lower than if they were to use Firefighter paramedics to staff the ambulances. The ambulance personnel that are hired are chosen by the fire departments based on the departments' criteria. This model enables the departments to

recruit full time employees from the pool of ambulance employees. Typically, the ambulance employees are trying to be hired as full-time firefighters. Knowing this, the departments are able to set their hiring criteria for ambulance drivers and attendants at a level that meets the departments' minimum acceptance standards for employment as a Firefighter. Since the departments are using their ambulance transportation program as a recruitment tool, they have the opportunity to objectively evaluate the employees based on actual work conditions which they will be working under if they were to be hired as a full time Firefighter.

A fire based EMS delivery system that utilizes paramedic ALS squads or ambulances along with fire engines staffed with BLS personnel as first responders "is a traditional or back-loaded-system." These systems are based on the engine companies (first responders) arriving on scene first to an emergency followed close behind by the ALS capable unit (squads or ambulances). A fire based EMS delivery system that puts ALS equipment along with ALS personnel (paramedics) on existing first response vehicles (engines or truck companies) is called a "front-loaded system" (Blaul, 1997). The latter model reduces the ALS response time, thereby increasing the level of service provided.

Response time is also a factor that must be considered. Fire stations are strategically located throughout a jurisdiction based on the ability for fire apparatus to arrive at any given location within their jurisdiction in an adequate amount of time to control the spread and confine a fire to the area of origin. EMS services, however, were an afterthought to a long tradition of fire suppression. Ambulances are generally spread thin, usually covering several fire station jurisdictions. This fact lends itself to longer response times by ALS

units (ambulances or squads) for most fire departments, regardless if the ALS units are a third service or a fire department service. While fire department engine companies continue to be the first unit on scene delivering BLS service, the units that provide the ALS service are the second or third unit on scene. For a patient who requires prompt evasive ALS level treatment, the extended response time by the ALS unit could be detrimental to patient care.

The infrastructure is already in place for paramedic engine companies. Fire stations are located within communities in such a manner that guarantees "comprehensive coverage and rapid fire response" not only for fire responses, but also for EMS responses. Front-loading engine companies with paramedics and ALS equipment in an existing department is a value-added service. The staffing and response vehicles which make up the majority of the cost of an EMS service are already in place, making the cost for additional training and ALS equipment negligible by comparison (Maurno, 1996).

In the book, *Managing Fire Services* Jim Page profiles six fire service models for delivering emergency medical services. Model "D" is a profile based on the use of non-sworn civilian employees employed by the fire service to operate ambulances. These civilian employees would be trained as paramedics and work at a pay rate considerably lower than that of a full-time Firefighter. (International City Management Association, 1979). This type of profile for fire service based EMS is predicated on the traditional theory that firefighters are truly in place for fire suppression activities. However, this was a profile written about in 1979. Today, the majority of fire departments accept the realization that fires have decreased in the last decade to the point that staffing levels cannot be justified

on fire suppression efforts alone. The fire service has naturally taken on the role of the primary provider of emergency medical services in the last two decades. Model "D" that Jim Page describes in the book *Managing Fire Services* can be taken a step further in the 1990's and into the year 2000.

As discussed earlier, there is no funding mechanism for first responder. In order to maintain funding a mechanism to support an EMS delivery system, a department must establish or maintain a transportation aspect of their EMS delivery system.

PROCEDURES

Response time data was also analyzed to determine the response time of the two paramedic ambulances responding into any of the other three station jurisdictions, as well as the response times for each engine in their respective districts. A cost analysis was conducted to establish the relative cost effectiveness of staffing two ambulances with Firefighter paramedics provided by the department versus the cost of staffing BLS ambulances with ambulance attendants provided by an employment agency.

A literature revue was conducted using resource obtained from the learning resource center at the National Fire Academy, articles from professional journals, and several books on public administration. Information was also obtained from other fire departments that use non-sworn ambulance attendants and Employment Systems Incorporated, who supplies personnel to operate ambulances on a contract basis.

To establish the criteria for defining an ALS population versus a BLS population, the criteria used was established by the California State Emergency Services Authority (EMSA). The standard was found in a document published by the EMSA called the *Emergency Medical Services Data System Standards 1993.* In this publication, the EMSA defined ALS level and BLS levels of care by the procedures and medications provided by the caregiver to a patient on a call.

When conducting the retrospective review for the past four years, the above criteria was used to determine whether, a call was at the BLS level or the ALS level. This was easily determined from the procedure and medication elements collected on the patient run reports. The ALS level call is defined as a call in which at least one ALS procedure was

performed or at least one medication was administered. All other calls by default were classified as a BLS level call, although reports were also developed defining BLS level calls based on the criteria established by the EMSA in order to confirm the ALS report.

One modification was made to the criteria established by the EMSA and applied in the retrospective review. This was on the criteria of ECG monitoring. As part of the Alhambra Fire Department's standard of care, we include the application of the ECG monitor to all patients that we highly suspect of having a problem that may be cardiac in nature. Due to this, it very common for the paramedics to put a patient on a monitor as part of their assessment. This may not always be indicated based on the current protocols the paramedics follow. For this reason, the retrospective review also included a more in-depth analysis of the criteria "ECG monitor." ECG monitoring was further defined to include only the following rhythms:

- Sinus Bradycardia
- Paroxysmal Supraventricular Tachycardia
- Supraventricular Tachycardia
- Second Degree Heart Block
- Third Degree Heart Block
- Ventricular Tachycardia
- Ventricular Fibrillation
- Ideoventricular Rhythm
- Agonal Rhythm

- Accelerated Ventricular Rhythm
- Asystole
- Pulseless Electrical Activity

The report was further broken down into transport type. There are seven options for this field. They are:

- No Transport
- Helicopter
- Ambulance
- Ambulance & Medic
- Fire
- Police
- Private Vehicle

Because the Alhambra Fire Department transports all patients regardless if they are ALS or BLS patients in an ALS ambulance with Firefighter paramedics, the Ambulance & Medic element was the significant factor. Data collected in the fields Ambulance and Fire were data entry errors that had no significance. In addition, the No Transport and Private Vehicle transport fields were analyzed as significant data to determine the efficiency of the department's EMS delivery system.

Once the patient populations were established and BLS versus ALS call load was determined, an average and variance report was run to determine the average time ALS resources were unavailable for subsequent calls while assessing, treating, and transporting patients meeting BLS level criteria. Reports were also run using the ALS resources on

ALS criteria. In addition, average and variance reports were run with BLS units on both ALS and BLS criteria. The purpose of these reports was to establish if the appropriate resources are being provided to the appropriate patient, as well as to determine if ALS ambulances are being tied up transporting a significant amount of BLS patients to the hospital.

Response times were analyzed for each engine company station jurisdiction. Each engine companies''s response time for their own jurisdiction was reviewed as was the response times of both paramedic units into each of the adjacent three districts. The purpose of this report was to establish whether or not the first-in engine companies responding in their districts arrive on scene prior to the arrival of the ambulances.

Financial reports were obtained from the city's finance department, as well as the ESI Corporation, in order to compare the cost of staffing two BLS ambulances. The reports revealed the total personnel cost of 18 paramedic firefighters versus the cost of 18 ambulances attendants contracted through the ESI Company.

RESULTS

Information on Employment Services Incorporated (ESI) was supplied by the Huntington Beach Fire Department and from the Downey Fire Department that solicited bids from ESI for the cost of ambulance employees. The total cost for 18 ambulance employees supplied from ESI is $451,546 annually. The total cost for 12 ambulance employees, supplied from ESI is $308,482 annualy. The City of Alhambra Finance Department supplied information on the cost of firefighter paramedics. The Total cost per Firefighter/paramedic annually is $73,344.58 based on 18 employees, for an annual cost of $1,320,202.42. (Appendix A)

The data shown in the attached Appendix B tables details the response times of the two ALS ambulances (Medics 71 and 72) into the three station jurisdictions adjacent to their own districts (Stations 71 and 74's districts). The important times that were significant to this study were the four and six minute time frames. These times are significant because four and six minutes represent the important time frames included in the chain of survival for patients suffering a cardiac arrest. The data represents response times for the years 1995, 1996, and 1997. Response times for the ALS units (Medic 71 and Medic 74) were not reported, it is assumed that the response times in their own districts were better or as good as the engine companies in their districts. Not taken into account were incidents in Medic 71 and Medic 74 districts when the units were on another call or at the hospital out of their districts resulting in a delayed response.

The significant figures to look at are the differences in response times between the BLS and ALS units when the ALS units responded out of their districts into an adjacent

district. Specifically, Medic 71 responding into Stations 72,73, and 74 districts and Medic 74 responding into Stations 71, 72, and 73 districts.

The data in Appendix B tables show Medic 71 with a response time of four minutes or less 11% of the time in Engine 72's district, six minutes or less 54% of the time, and eight minutes or less 89% of the time. A response time in Engines 73's district of four minutes or less 13% of the time, six minutes or less 70% of the time, and eight minutes or less 94% of the time. A response time in Engines 74's district of four minutes or less 11% of the time, six minutes or less 27% of the time, and eight minutes or less 75% of the time.

These tables show Medic 74 with a four minute or less response time in engine 72 district 89% of the time, six minutes or less 51% of the time, eight minutes or less 89% of the time. Medic 74 had a response time of four minutes or less in 73 district 15% of the time, six minutes or less 70% of the time, and eight minutes or less 95% of the time. Medic 74 had a response time of four minutes or less in Engine 71's district 12% of the time, six minutes or less 24% of the time, and eight minutes or less 75% of the time.

The data shown in Appendix C tables details the response times for each engine company in their districts. All engine companies had a response time of four minutes or less averaged over the three year period 30% of the time with the exception of Engine 72, which had a four minute or less response time 22% of the time. All engine companies had a response time of six minutes or less averaged over three year period 81% of the time. All engine companies had a response time of seven minutes or less averaged over the three-year period 91% of the time. All engine companies had a response time of eight minutes or less over 90% of the time.

Appendix D tables identifies the level of call (ALS and BLS) based on the criteria established by the California State Emergency Medical Service Authority with a modification to the ALS criteria that includes identified EKG rhythms. The reports were broken down by ALS units (paramedic ambulances) and BLS units (engine companies) and correlated with call type, as well as patient disposition (transported to the hospital, not transported and private vehicle). The reports were run to give an average and variance time the units were on the call, from time of dispatch to time the units were available, under the parameters established. The data reflects EMS calls for the years 1997, 1996, 1995, and 1994.

The results in Appendix E indicate that in 1997, the paramedic ambulances transported 1,204 ALS patients to the hospital with an average time on each call of 40 minutes and transported 1,075 BLS patients to the hospital with an average time of 34 minutes for each call. In 1996, the paramedic ambulances transported 1,241 ALS patients to the hospital with an average time of 39 minutes on each call and 1,209 BLS patients to the hospital with an average time of 33 minutes for each call. In 1995, the paramedic ambulances transported 1,221 ALS patients to the hospital with an average time of 39 minutes for each call and 1,159 BLS patients to the hospital with an average time of 33 minutes for each call. In 1994, the paramedic ambulances transported 1,126 ALS patients to the hospital with an average time of 39 minutes for each call and 1,115 BLS patients to the hospital for an average time of 33 minutes for each call.

The tables also show the average time paramedic ambulances spent on a call that met both ALS and BLS criteria, but the patient was not transported to the hospital. The

calls that fell into the ALS criteria were not significant. These patients were either pronounced on scene or refused treatment and transport to the hospital. The BLS calls were significant because these calls accounted for time that the units were unavailable for subsequent calls during this time.

In 1997, the paramedic ambulances were on scene for an average of 18 minutes on each call for 769 patients that met BLS criteria and were not transported to the hospital nor did they go to the hospital in a private vehicle. In 1996, the ambulances were on scene for an average of 17 minutes on each call for 738 patients that met BLS criteria and were not transported to the hospital. In 1995, the paramedic ambulances were on scene for an average of 17 minutes on each call for 790 patients that met BLS criteria and were not transported to the hospital. In 1994, the paramedic ambulances were on scene for an average time of 17 minutes on each call for 722 patients that were not transported to the hospital.

In 1997, the paramedic ambulances were on scene for an average time of 17 minutes for each call on 98 BLS patients that were transported to the hospital in a private vehicle. In 1996, the paramedic ambulances were on scene for an average time of 20 minutes for each call on 105 BLS patients that were transported to the hospital in a private vehicle. In 1995, the paramedic ambulances were on scene for an average time of 17 minutes for each call on 60 BLS patients that were transported to the hospital in a private vehicle. In 1994, the paramedic ambulances were on scene for an average time of 16 minutes for each call on 68 BLS patients that were transported to the hospital in a private vehicle.

DISCUSSION

This study identified several departments who have experienced success with the paramedic engine concept for various reasons. Few, however, approached the subject by analyzing their department's patient populations by retrospectively reviewing patient care reports or data collected from the reports. Most of the literature reviewed was based on a departments desire to deal with an increasing EMS call volume without identifying what type of calls (ALS or BLS) made up the call volume and what level of service was indicated based on this information. As identified in some of the literature the cost effectiveness of using firefighters in a dual role for fire suppression activities and EMS activities adds to the cost effectiveness of a department.

The cost analysis comparison done in the study dealt strictly with personnel cost with the understanding that the infrastructure was already in place and that any additional service would be value added at no additional cost. However, the cost effectiveness of an EMS delivery system would have to take into account the cost of all personnel delivering the service, not just the personnel that transport the patient.

The study results certainly define some positive aspects of the paramedic engine company concept particularly for larger departments who are experiencing increased call loads and limited ALS resources. With fire stations, engines and personnel already in place the cost of implementing paramedic engine companies to handle an increased call load is minimal for a department entering into or increasing the level of EMS service they provide.

The results of the study clearly indicates a disparity between the personnel

resources available on the Alhambra Fire Department and the allocation of those resources in the delivery of emergency medical services. As the demand for emergency medical services, increase the allocation of resources available to handle these demands become crucial. Based on the patient populations identified, the volume of calls representing ALS calls in all four years was 38%, with the exception of 1997, which had an ALS call load of 36%. The remaining BLS calls accounted for 62% and 64% respectively. In order to ensure the highest level of care possible, it is essential that all request for emergency medical services initially get an ALS unit to assess and determine the level of care needed. However, once a call is determined after an assessment to be a BLS call, the appropriate life support unit should be available to treat and transport the patient to a hospital if indicated. Putting all the department paramedics on engine companies and staffing ambulances with BLS personnel would increase the delivery of the department's EMS system by increasing ALS response time on initial response in all four station jurisdictions. This would also add to the efficiency of the system by allocating the appropriate resource to the appropriate level of call. The ALS coverage would increase to a level of maximum capacity with little cost increase to the department.

RECOMMENDATIONS

The study revealed a disparity between the amount of ALS resources (personnel) the department employs and how they are utilized. Increasing engines' 72 and 73 to the paramedic assessment engine level has improved the efficiency of the department in terms of utilizing its personnel resources. While this, has increased the level of service provided.

The literature reviewed showed some positive operational aspects to implementing paramedic engine companies. However, there was no clear analysis done regarding what the patient populations were for the departments that have implemented paramedic engines.

Some areas of concern brought out in this study that will have to be analyzed further, are the departments dispatching procedures, patient triage and tiered dispatching. The response times identified in the study were longer than anticipated

The call deferential between ALS and BLS patients indicates that we are committing ALS resources to a large percentage of BLS level calls when BLS level care would be appropriate. Implementing paramedic engines would decrease the response time of ALS units. Making all engines fully ALS capable would ensure an equal level of protection to all areas of the community. With the resources already in place the cost would be minimal.

The research indicates that paramedic engine companies work well in the Alhambra department. The concept would enhance the level of care provided to the citizens of Alhambra and allow a more efficient use of resources. The transportation

aspect would have to be looked at more closely in order to analyze the cost of managing a BLS ambulance transportation program. One possibility might include staffing BLS ambulances with firefighter EMT's already on the department. Allocating the appropriate resource to the appropriate patient is essential too effectively and efficiently delivering the highest level of care possible.

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