Colerain Township Department of Fire & Emergency Medical Services BLS-ALS Delivery Study

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A research project submitted to the Ohio Fire Executive Program.

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CERTIFICATION STATEMENT

I hereby certify that the following statements are true:

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

2. I have affirmed the use of proper spelling and grammar in this document by using the spell and grammar check functions of a word processing software program and correcting the errors as suggested by the program.

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ABSTRACT

The problem was Colerain Fire and EMS had not formally reviewed its EMS delivery since 1989. The purpose of this project was to evaluate the current system and several alternate delivery models for improving EMS delivery. The project was conducted using descriptive, action, and evaluative research to identify: a) what the projected fire-rescue and EMS responses will be through 2009, b) what the annual cost of the current BLS-ALS system is compared to the alternative models, c) will there be enough EMTs and paramedics to staff the proposed models, d) how will the alternative models will impact operations.

The procedures used included a literature review, review of hourly personnel costs, and review of EMS certifications.

The research indicates an avenue for decreased cost of EMS delivery as well as providing personnel to staff station 109. There are disadvantages identified such as, insufficient number of paramedic's and the possibility of staffing five BLS-ALS units and upgrading two engine companies to paramedic engine companies.

TABLE OF CONTENTS

CERTIFICATION STATEMENT	2
ABSTRACT	2
INTRODUCTION	5
Statement of the Problem	5
Purpose of the Study	6
Research Questions	6
BACKGROUND AND SIGNIFICANCE	7
LITERATURE REVIEW	12
PROCEDURES	16
Limitations of the Study	23
RESULTS	25
DISCUSSION	29
RECOMMENDATIONS	36
REFERENCES	38
APPENDIX 1 – 2000 - 2009 Fire Incident Projections	40
APPENDIX 2 – 2000 - 2009 EMS Incident Projections	41
APPENDIX 3 – Current Personnel cost	42
APPENDIX 4 – 2009 BLS-ALS projected personnel cost	43
APPENDIX 5 – 2009 ALL ALS projected personnel cost	44

APPENDIX 6 – 2009 PROJECTED staffing 45

INTRODUCTION

Statement of the Problem

Over the years, the requests for emergency services have grown in Colerain Township, Ohio. The department is combating an increased request for emergency medical services with the same number of personnel and types of apparatus as when the paramedic service began 15 years ago. More significantly, the types of services requested have largely fallen outside the scope of "basic" or traditional fire suppression and emergency medical activities. The fire department organization anticipates that the next several years will be a period of dynamic adaptation and innovation.

The fire department's emergency medical service (EMS) delivery has evolved from a primitive victim transportation system to a complete system of pre-hospital care. The EMS system currently includes two basic components - Basic Life Support (BLS) provided by Basic and Intermediate Emergency Medical Technicians and definitive care Advanced Life Support (ALS) provided by paramedics.

The problem this study will investigate is the Colerain Township Department of Fire and Emergency Medical Services (Colerain Fire and EMS) paramedic service delivery component, which has virtually been unchanged since its inception. There have been modifications in the program to address regulatory issues, protocol changes, and various issues that arose along the way. This problem prevents the organization from achieving its mission by not providing the absolute highest quality emergency medical services. Until this problem is reviewed, the quality and effectiveness of the emergency medical services is not fully realized.

Purpose of the Study

The purpose of this research project is to determine whether the current delivery of emergency medical service will best meet the projected demands for future service through the year 2009, supported by providing the organizations' administration with an analysis of the current system, and offering alternative service delivery models for consideration that affords the organization and its customers an improved emergency medical delivery system at an affordable cost.

Research Questions

This study will use the following research methodologies: (a) descriptive research to describe the current emergency medical service delivery system; (b) evaluative research to evaluate the effectiveness of the current emergency medical service delivery system; (c) action research to provide alternative service delivery models to improve the efficiency of the current system. The following research questions are posed:

1. What is the projected number of fire-rescue and emergency medical service incident responses through 2009?
2. What is the annual cost for the current BLS - ALS system compared to the proposed alternative EMS delivery models?
3. What will be the number of paramedics and emergency medical technicians (EMT) needed to staff the alternative EMS delivery models?
4. How will the alternative EMS delivery models impact other aspects of emergency operations?

BACKGROUND AND SIGNIFICANCE

The Colerain Township Department of Fire and Emergency Medical Services is located in northwestern Hamilton County and is currently the largest township in Ohio. The department provides 100% of the fire protection and emergency medical services for an area approximately 43.2 square miles with a current resident population of 62,500. Identified in the Colerain Township *Master Plan 2001-2020,* based on information obtained from the Hamilton County Regional Planning Commission's, *Decision Support Manual – Volume 1*, the township's current population of 62,500 is expected to reach 69,900 by the year 2010. The business day population averages from approximately 95,000 to 100,000 people.

Colerain Township primarily is a suburban area with rolling hills and mostly residential dwellings. The township has the average amount of retail business centered along the main route of travel through the township and scattered throughout the community. There is a small amount of industrial businesses in the township.

The largest employer in the township is the Northwest Local School District, which employs approximately 1247 employees (M.L. Seurkamp, personal communication, August 2003). The second largest employer in the township is Rumpke Consolidated Companies, which employs approximately 715 employees (C. R. Cabe, personal communication, September 2003).

In July 1989, Colerain Fire and EMS began providing paramedic service to the community to enhance the BLS. Since this time, the program has operated from two non-transport paramedic units with a crew of two paramedics each and four BLS ambulance with a crew of two EMTs each, 24-hours a day, seven days a week. The original paramedic service delivery model is still in place today. The department has steadily increased staffing over the last 15 years. The department's fire and EMS delivery has been on a steady growth path and

continues to increase yearly. In fact, the emergency incident volume has nearly doubled since 1989. "Since 1990, the fire department has experienced a 54% increase in fire and rescue incident responses and a 71% increase in emergency medical incident responses. These significant increases in incident responses have ranked the department second busiest to the City of Cincinnati Fire Division in Hamilton County" (Colerain Fire-EMS 2000, p. 15).

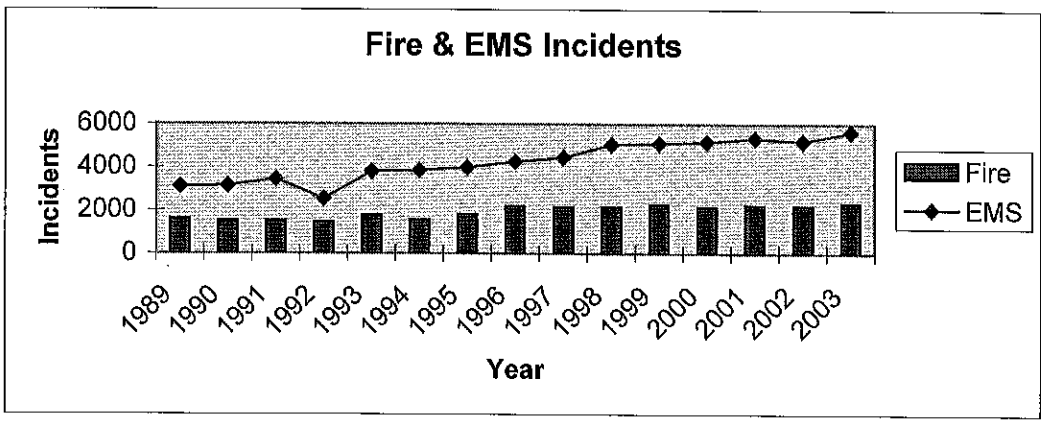

Figure 1

Colerain Fire - EMS incidents from 1989-2003.

According to the department's master plan, "Of the 5,060 emergency medical incidents that occurred in 1998, the department experienced 1,429 occurrences of two or more ambulances out-of-service (O.O.S.) providing victim care or transporting victims of emergency medical incidents. This represents 3,304 of the total incidents for the year" (Colerain Fire-EMS, 2000, p. 41).

Table 1

Frequency of multiple EMS incidents

Transport Units	Out-of-Service
2 Transport Units	1040
3 Transport	332
4 Transport	57
Total	1,429

The department currently provides fire suppression from four fire stations strategically located throughout the township with 31 paid on-duty personnel. Two of the four fire stations, Station 102 and 103 are staffed with four person engine companies in the remote areas of the community that provide fire protection and first responder paramedic service. The remaining two fire stations are staffed with the following apparatus: (a) Station 25 – one engine and ladder company, one water tanker, one paramedic unit, and two BLS ambulance units; (b) Station 26 – one engine and rescue company, one water tanker, one paramedic unit, and two BLS ambulance units.

The EMS fleet consists of two ALS paramedic units and four BLS ambulances with one spare BLS ambulance as a reserve unit.

The construction of a fifth fire station is underway with a projected completion date of October 2004, which will be located in the northeast section of the township. This fifth fire

station will have one engine company staffed with four personnel providing fire protection and first responder paramedic service.

Prior to the implementation of the paramedic program, the department provided emergency medical services with four BLS transport units. The paramedic program began with the hiring of six career paramedics and several supplemental part-time paramedics to staff two paramedic units. Each unit is assigned two paramedics. Four BLS ambulances staffed with two EMTs each provide victim transportation. The remaining two BLS ambulances do not have dedicated personnel for staffing; therefore, personnel are shifted or pulled from a fire company to staff these two BLS ambulances. This current practice decreases staffing on the fire apparatus by a minimum of four personnel and up to eight personnel if two paramedics are required for victim transport to a medical facility. This creates other apparatus staffing issues regarding personnel safety and meeting current regulations for fire ground and emergency operations.

Table 2

Potential staffing shortages during multiple emergency medical incidents

O.O.S. Transport Units	Requirement of Personnel	
Three Transports	Firefighters/EMTs	2
	Paramedics	2
Four Transports	Firefighters/EMTs	2
	Paramedics	2
	Total	8

Historically, the increased incident volume for emergency medical service has impacted the safe staffing levels of fire suppression units. Compounded by the fact that request for

firefighting services is also on the increase, a strain is placed on the overall delivery of fire protection and rescue services.

In terms of probable future impact this study will attempt to identify the factors that will influence the organizations' ability to deliver service as demand for emergency medical service steadily increases, and offer an effective alternative solution for the department through 2009 at an affordable cost to the township's citizenry.

LITERATURE REVIEW

The purpose of this literature review is to gather information and answer the research questions to guide the department in the direction of providing the best EMS delivery model without bias to any specific individual or groups interest.

Research Question 1

Information used to evaluate the projected incident responses included a review of past incident response statistics and the Colerain Fire and EMS *2001-2010 Master Plan*. According to the plan,

> It is anticipated that over the next ten years the amount of activity involving the delivery of emergency medical incidents may increase by at least 50%". The document indicates that 75% of the total emergency response activity is for the provision of emergency medical services. In 1998, paramedics responded to 65 % of the total emergency medical incidents. Thirty percent of the total emergency medical incident victims were transported with paramedics. The national paramedic intervention and transported average is 25%. As with the anticipated increase in emergency medical incidents, fire and rescue incidents are also anticipated to increase in the next ten years by 39%. (Colerain Fire – EMS, 2000, p.21)

According to P. Michael Freeman, "At the beginning of the twenty-first century, EMS accounts for 70 to 80 percent of annual emergency responses made by fire departments" (Compton and Granito, 2002, p. 129).

Research Question 2

In an article written by Sachs that addresses upgrading EMS services from BLS to ALS he states,

> Upgrading from BLS to ALS is not cheap. Local and state requirements typically mandate that specific medical equipment, supplies, and medications be carried on ALS response units. Depending on these requirements, the cost can range from $10,000 to $20,000 per unit. (1997, p. 110)

Additional information used to evaluate annual cost to operate the Colerain's current BLS – ALS system included a review of the collective bargaining agreement between the *Colerain Township Board of Trustees and International Association of Firefighters Local 3915 Colerain Township Career Firefighters* and the wage-scale for part-time personnel to determine associated salary cost to offer alternative staffing configurations for alternative delivery models.

Start-up costs for fire department EMS programs entail training expenses, the purchase of vehicles, and specialized medical equipment. The *Fire Station Management Advisor* newsletter identifies, " The greatest expense associated with any operation (an estimated 90 percent) is personnel salaries" (1996, p.3).

Research Question 3

The United States Fire Administration (USFA) publication *Implementation of EMS in the Fire Service* addresses the issue of adequate staffing by stating,

> Either the call volume is too high or the public's expectation for service is such that there is no way that apparatus can be crossed staffed. This generally means that additional personnel will be needed to ensure that each piece of apparatus can be dispatched independently. (1997, p. 52)

Brent Browett's research in the early 1990's indicated,

> "A comparative analysis of ALS: ALS and ALS: BLS-D (defibrillation) crew combinations was undertaken to determine if ALS vehicle coverage could be safely increased by splitting all of our dual ALS crews into mixed ALS: BLS-D. This information may be useful to other EMS systems with ALS staffing shortages or that are seeking safe ways to contain costs associated with staffing ALS units. Browett, (1992, p. 13)
>
> Browett went on to provide additional insight on staffing EMS units by stating, Where an EMS system bears additional cost associated with staffing a transport ambulance with ALS: ALS vs. ALS: BLS-D, … and there are a limited number of paramedics available for ALS vehicle coverage, we recommend the use of ALS: BLS-D crew combinations. (1992, p. 15)

Research Question 4

In Warren Township, Indiana, the National Fire Protection Association (NFPA) 1710, *Standard on Operations for Career Fire and Rescue Departments* provided a tool to measure fire department performance and response capabilities.

> The additional paramedics will provide the capability to meet the standard requirement of two paramedics on all ALS responses. Their addition to the medic trucks will also will also enable the re-assignment of firefighters from medic trucks, to firefighting apparatus, to bring the department closer to meeting minimum manning levels required by the standard. (Warren Township, 2003, ¶ 5)

According to the USFA, *Implementation of EMS in the Fire Service* identifies additional workload as an impacting factor in fire department organizations. "For the agency, this can be

measured in terms of increased call volume and unit service time (i.e., the amount of time each piece of response apparatus is committed to a call)" (1997, p. 5).

Morris discusses the disadvantages relative to paramedic engine companies in a 1993 *Fire Chief Magazine* article,

> For departments implementing a paramedic engine company program start-up cost is a factor. They can include training expenses and purchases of specialized medical equipment. However, substantial savings through eliminating the need for a separate two-person medic unit offsets these start-up costs. (p. 42).

Goebel, Gorman, and Jensen discusses the advantages of fire-based EMS transportation an a 1997 *Fire Chief Magazine* article, "It's important to note that, unlike most private providers, fire-based EMS transportation providers typically provide both transport and first-response services. In addition, personnel on these units typically respond and assist on fire suppression activities." (p. 42).

In summary, the reviewed literature has influenced this research project by demonstrating an established need to explore alternative emergency medical service delivery methods. The information obtained form this literature will be used to support the recommendations contained within this research project to provide alternative EMS delivery models that will provide effective and affordable services.

PROCEDURES

The purpose of this applied research project was to develop a document that evaluates the current delivery of EMS provided by Colerain Township Fire and EMS. Descriptive, action and evaluative research methodologies were utilized to help direct the project to find answers to the research questions.

The development of the project began with instruction in research utilization and writing research papers by participating in the "Ohio Fire Executive Program" (OFEP) at the Ohio State University campus using the *OFEP Course Manual*, *OFEP Operational Policies and Procedures Applied Research Guidelines*, and the *American Psychological Association* 5th edition text in June 2003. Research and data collection began with a literature review conducted at the request of the author via an e-mail correspondence to the National Fire Academy's (NFA) Learning Resource Center (LRC) in Emmitsburg, Maryland in September 2003. Articles from fire service trade magazines; submitted Executive Fire Officer Program research projects, fire service textbooks, and related literature were reviewed for information relevant to this research project. An additional review of information was conducted on the Internet using a Boolean search as an additional method of acquiring resource information related to this research project. A review of Colerain Fire and EMS documentation was also conducted, which included *2001-2010 Master Plan,* salary scales, personnel certification level data, and fire and EMS incident statistical data. Also, the author's personal collection of fire service profession texts was reviewed for relevant information that was applicable.

The criteria used to help focus on and identify information for this project had to be first pertinent to the purpose and subject matter of this research project. Second, the information had to be as current as possible.

Forecasting Technique

The technique for linear regression using historical data on the patterns of fire and EMS incident responses to predict the probable demand in the future uses the following directions:

> Each key of a business calculator has two entirely separate functions. The first purpose of the key is printed directly on the key itself. For example, the keys with the numbers 0 through 9 will enter a number in the calculator when pressed. This is called the primary function of the key.
>
> Each key can also perform an entirely different secondary function. However, to get it to perform the second function, you must first push a special button. This changes the function from the standard, which is printed on the key itself, to the secondary function, which is printed on the face of the calculator, directly above each key. On the Hewlett Packard line, this special button is found in the lower left corner of the calculator, directly above the on/off button. It is a solid yellow button, called shift key.
>
> Whenever it is pressed, it activates the secondary function of every button on the calculator. It is called the shift key because it shifts the function from the primary to the secondary. Therefore, the next key you press will perform the secondary function, written above the key, not the function key itself. It stays activated for only one push of a key. If the next step you want to take on the calculator is also secondary function, you will have to press the shift key again. If you need to perform several secondary functions in a row, hold the shift key down with one finger, while you press the keys with the other.

You will be instructed to push the shift key before any secondary function that must be done on the calculator.

This calculator retains information in its memory even when shut off, so you must always clear memory when starting a trend line analysis.

1. Push shift key, CL$\sum$ (this is written in yellow above the key). It is located to the right of the large INPUT button. This clears all previous information.
2. Push 86 (the year), then the input button. It is located in the left center of the keyboard.
3. Push 970 (the number of calls), then the $\sum$+ button. It is located in the upper right-hand corner.

   This enters the first pair of numbers, and the number 1.00 appears on the display stating fact. The calculator will always display the number of pairs you currently have in its memory. Continue this same process until all the data are entered for the years 1986 to 1990:
4. Push 87 (the year), then INPUT button.
5. Push 1096 (the number of calls), then the $\sum$+ button.
6. Push 88 (the year), then the INPUT button.
7. Push 1153 (the number of calls), then the $\sum$+ button.
8. Push 89 (the year), then the INPUT button.
9. Push 1305 (the number of calls), then the $\sum$+ button.
10. Push 90 (the year), then the INPUT button.
11. Push 1442 (the number of calls), then the $\sum$+ button.

To forecast the number of calls, which will occur in 1991, enter that year and then push the button for the forecast value of calls: y, m:

12. Push 91, the shift key, then y, m (found directly above the 5 key).

The forecasted number of calls for 1991 appears on the display: 1539.1.

To find the calls for 1992, repeat step 12 using the year 92:

13. Push 92, the shift key, then y, m.

The forecast this time is 1654.4.

You may also forecast from the other direction. For example, if you decide that you must add another engine company when the area has 1800 calls, you need to know when you will reach 1800 calls. Just enter that number and calculate the year:

14. Push 1800, the shift key, then x, r.

The forecast is 93.26, which means one quarter through the year 1994, (March of 1994), [*sic*] the department should reach 1800 calls on an annual basis (NFA, 1992, pp. 60-62).

Estimated Cost Calculations

To determine the current cost of staffing EMS units and the projected fiscal impact of the proposed service delivery models contained within this project, the following steps outlined by Zavadsy (2003) in *EMS Insider* were utilized:

Start by determining the agency's total-budget for a defined period, including all overhead and administration. Next, calculate the number of hours that primary response units are on duty. *Example:* [sic] One staffed engine on duty 24 hours a day, 365 days a year, generates 8,760 unit hours (24 x 365). If the agency has four

> stations, each with two primary response units on duty 24/365, the department's total unit hours is (4 x 2) x 24 x 365 = 70,080.
>
> Now, take the agency's total budget and divide it by the total number of unit hours. In our example, if the department budget is $ 5.1 million, divide that by the 70,080 unit hours for a unit hour cost of $ 72.77. (p. 6)

Division Chief Greg Brown of the Colerain Fire - EMS using the Zavadsy formula to determine a unit hour cost, completed the estimated cost analysis. *Example:* Fifteen staffed units on duty 24 hours a day, 365 days a year, generates 131,400 unit hours (15 x 24) x 365 = 66.13 per unit hour. This projection is for all the department's overhead and expenses associated with EMS delivery.

Using the "Brown Method" to determine the average cost of personnel only, he averaged the hourly rates based on a two person BLS unit and a two person ALS unit staffing configuration, and determined the cost by dividing the sum of the hourly rates by the number of different pay rates for each unit type.

Using the "Silvati Method" to determine the average cost of personnel only, the career paramedics and company officers were selected as well as the part-time EMTs, paramedics, and company officers. The average hourly rate was determined by dividing the sum of the hourly rates by the number of different pay rates.

The 2009 projected staffing costs were based on an average 3% increase for each year including 2009, which were applied to the 2009 Brown's and Silvati's methods of personnel cost calculations.

Definition of Terms

Action research - taking action to solve an existing problem and/or to improve performance (NFA, 2003, p. II-26).

Advanced life support (ALS) – functional provisions of advanced airway management, including intubations, advanced cardiac monitoring, manual defibrillation, establishment and maintenance of intravenous access, and drug therapy (NFPA, 2003, p. 5).

Ambulance – special vehicle equipped to transport sick or injured people to medical facilities. (Brakhage et al., 1993, p. 163).

Apparatus – vehicle or group of vehicles of any variety used in the fire service (Brakhage, Smith, Wieder, 1993, p. 164).

Arrhythmia – any disturbance in the rhythm of the heart (Brakhage et al., 1993, p. 165).

Basic life support (BLS) - maintenance of airway, breathing, and circulation, as well as basic bandaging and splinting, without the use of adjunctive equipment. (Brakhage et al., 1993, p. 169).

Boolean search – a search that strings together several related terms (Ohio Fire Executive Program, 2003, p. 10). For example, asking the search engine to find EMS AND Staffing.

Descriptive research – determining and reporting the present status of something (NFA, 2003, p. II-25).

Electrocardiogram (EKG) – test used to observe the function of the heart. (Brakhage et al., 1993, p. 165). (Brakhage et al., 1993, p. 198).

Emergency Medical Service (EMS) – the organization(s) responsible for the care and transport of sick and injured persons to an appropriate emergency care facility (NFPA, 2003, p. 101).

Emergency Medical Technician-Basic – a person who holds a valid certificate to practice as an EMT-Basic. An EMT-basic may operate an ambulance and give emergency medical services to patients. Services may include determining the nature and extent of illness or injuries and establishing priority for required emergency services, opening and maintaining an airway, chest compressions, controlling hemorrhage, stabilizing fractures, assisting in childbirth, cardiac resuscitation, and any other services approved by adoption of a rule by the State Board of Emergency Services (Ohio Legislative Service Commission [OLSC], 2001, p. 42).

Emergency Medical Technician-Intermediate – a person who holds a current certificate to practice and an EMT-I. An EMT-I may perform the emergency services including the following: cardiac monitoring, electrical interventions to support or correct cardiac function, administering epinephrine, determining triage, and any other service approved by adoption of a rule by the State Board of Emergency Medical Services (OLSC, 2001. p. 42).

Emergency Medical Technician-Paramedic – a person who holds a current certificate to practice and an EMT-Paramedic. Paramedics may perform emergency medical services including cardiac monitoring, electrical interventions to support or correct cardiac function, airway procedures, relief of pneumothorax, administering appropriate drugs and intravenous fluids, triage of trauma victims, and any other services, including life support or intensive care techniques, approved by rule of the State Board of Emergency Medical Services (OLSC, 2001. p. 42).

Engine company –group of firefighters assigned to fire department pumper. They are responsible primarily for providing water supply and attack lines for fire extinguishment and exposure protection (Brakhage et al., 1993, p. 200).

Evaluative research – the systematic process of collecting and analyzing data in order to facilitate decisionmaking [*sic*] (NFA, 2003, p. II-26).

First responder - level of emergency medical training, between first aider [*sic*] and emergency medical technician levels that is recognized by the authority having jurisdiction. (Brakhage et al., 1993, p. 210).

Ladder company – group of firefighters assigned to a fire department aerial apparatus who are primarily responsible for search and rescue, ventilation, salvage and overhaul, forcible entry, and other fireground [*sic*] support functions. (Brakhage et al., 1993, p. 232).

Medic unit – ambulance staffed by paramedics. (Brakhage et al., 1993, p. 240).

Paramedic engine – a fire company that carries firefighter/paramedics and paramedic equipment. (Brakhage et al., 1993, p. 249).

Pneumothorax – accumulation of air in the plural cavity, usually after a wound or injury that penetrates the chest wall or lacerates the lungs. (Brakhage et al., 1993, p. 253).

Out-of-service – resources assigned to an incident but unable to respond for mechanical, rest, or personal reasons. The deactivation of a component for any purpose, including repairs or inspections. (NFPA, 2003, p. 242)

Rescue company – specialized unit of people and equipment dedicated to performing rescue and extrication operations at the scene of an emergency. (Brakhage et al., 1993, p. 264).

Limitations of the Study

The results of this research project were limited by several factors and should be noted. The first factor was a lack of other local departments providing EMS delivery in a configuration similar to the EMS delivery currently used by Colerain Fire – EMS. Most departments provide an all ALS system or a combination of EMTs and paramedics staffing ambulances, with the

support of paramedic engine companies for transport. Nationally, most departments provide first responder paramedic engine companies with BLS units, ALS units, or a combination of both to transport patients to the hospital. There was very little literature found to support a system that was identical or closely similar to the EMS delivery system currently used in Colerain Fire – EMS. Another limitation of the study was a lack of documented information pertaining to the effectiveness and efficiency of the EMS delivery system, therefore no foundation or subject matter for evaluation was available.

An assumption is made that the current EMS delivery system is acceptable to the community and is not a question to be addressed in this research project.

RESULTS

The results of the literature review provided the following answers to the research questions.

Research Question 1

The projected fire-rescue and emergency medical service incident responses through 2009 have been estimated to increase to 7,421 incidents. This increase was determined by using a forecasting technique known as "trend line analysis/regression analysis" using a business calculator and Microsoft® Excel. See Appendix 1 and 2 for a detailed illustration.

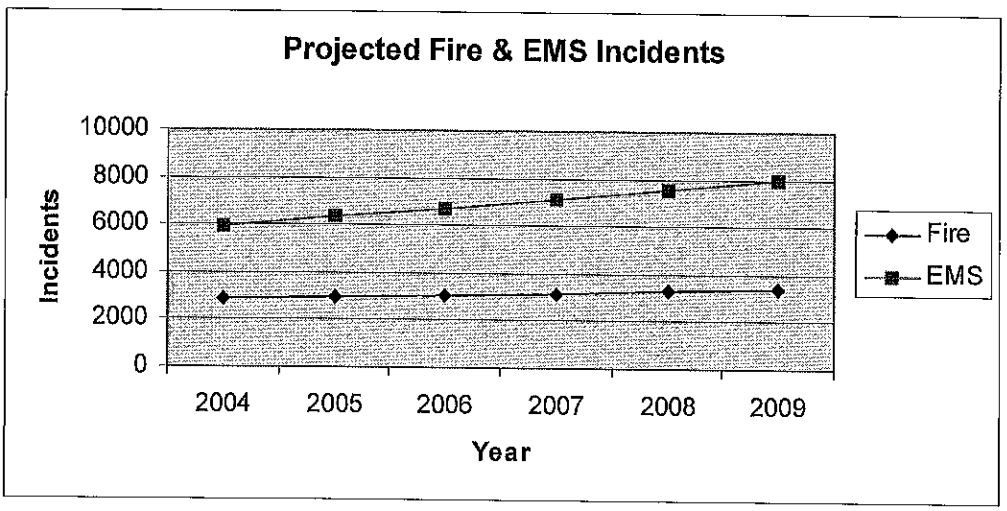

Figure 2

Colerain Fire – EMS projected fire and EMS incidents through 2009.

Research Question 2

The projected cost of the current system is $1,309,094.40 based on the "Brown Method" and $1,417,893.60 based on the "Silvati Method". See Appendix 3 for a detailed illustration. The 2009 projected cost for the proposed BLS-ALS system is $1,309.094.40 based on the "Brown Method" and $1,417,893.60 based on the "Silvati Method". The projected cost for the 2009

proposed All ALS system is $1,402,476.00 based on the "Brown Method" and 1,658,706.00 based on the "Silvati Model". See Appendix 4 and 5 for a detailed illustration.

Research Question 3

Will there be enough paramedics to staff the proposed service delivery models have been answered through the research process. Currently, six paramedics is the minimum career staffing level. The proposed delivery model requires one additional paramedic engine company (Engine 109) and transport unit (fifth ambulance). The numbers of paramedics and EMTs needed to staff the proposed BLS-ALS and all ALS alternative service delivery models are described in the following: (a) 10 paramedics and 15 EMTs for the BLS-ALS Model; (b) 15 paramedics for the all ALS Model. These staffing requirements are the minimum amount of paramedics and EMTs for each 24-hour tour of duty. See Appendix 6 for a detailed illustration. The current paramedic staffing average is 8.6 and 30.3 EMTs. These numbers do not take into consideration of scheduled time off or unscheduled absences. The research has provided sufficient data to suggest staffing an all ALS system would be difficult based on the number of paramedics required to staff each unit. The data suggest the organization has sufficient EMTs to support a BLS-ALS system and through planning and recruiting can increase the number of paramedics to support the all ALS system. See Appendix 6 for a detailed illustration.

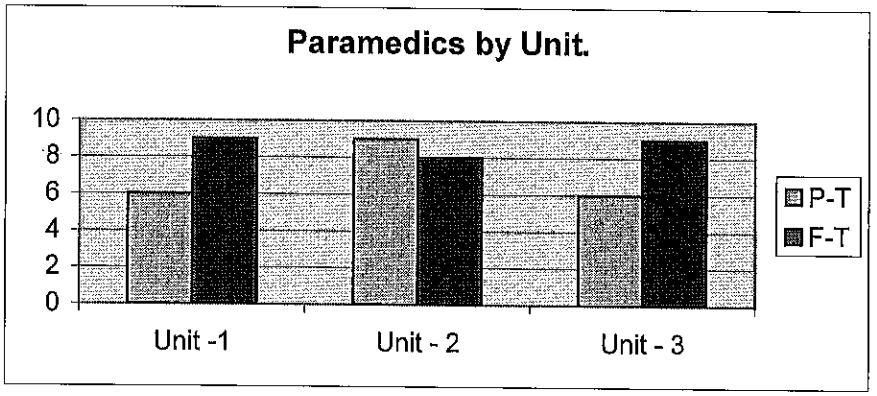

Figure 3

Colerain Fire – EMS current career and part-time paramedics by unit.

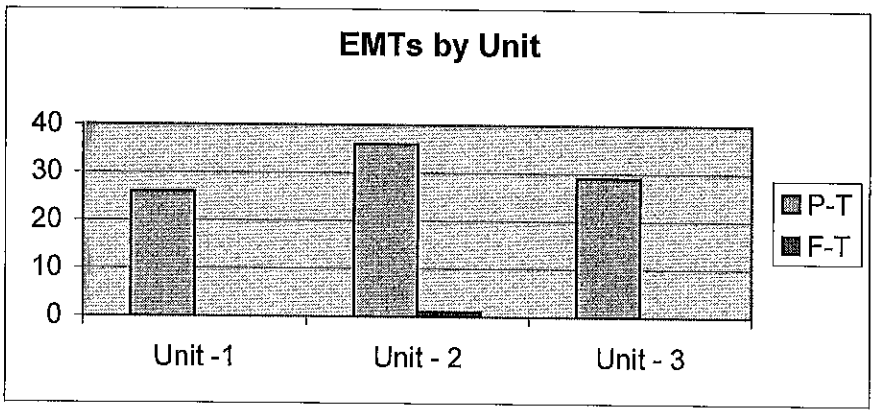

Figure 4

Colerain Fire – EMS current career and part-time EMTs by unit.

Research Question 4

The proposed alternative service delivery models will impact other aspects of emergency operations by increasing personnel assignments to other apparatus with the elimination of two paramedic units. The financial savings achieved as a result of the elimination of two paramedic vehicles and their associated cost of operation and maintenance. The customer is assured a higher level of emergency medical care with each incident response. For two of the five township's engine companies there will be a marked increase in emergency medical responses as a result of first responder activity and to provide paramedic support during multiple incidents and

complex scenarios.

DISCUSSION

Typically, departments in the southwest Ohio region that provide EMS do so in one of four ways: (a) ambulances staffed by two paramedics; (b) "chase vehicle" staffed by two paramedics; (c) fire apparatus designated as "paramedic/engine" companies, with two paramedics, plus two or more additional firefighters; (d) a combination of the aforementioned. Colerain Fire – EMS currently uses a combination of all the systems based on staffing to answer calls for service.

The results of this research project identified that there has not been an official documented assessment of Colerain's EMS delivery system, the organization's need to effectively measure the current EMS service, and establish a "yard-stick" to continually measure the future EMS service delivery.

Battalion Chief Frank Cook chaired the report committee for the department's master plan, which involved extensive research and combining the efforts of other committee members to prepare the document. Battalion Chief specifically used a forecasting technique called "trend line analysis/regression analysis" that uses historical data on the patterns of fire or EMS incidents to predict the probable demand in the future.

Nationally, in 1993 Fred Thorp identified a general decrease in the need for fire suppression personnel due to the decrease in fires over the years; the number of EMS responses has steadily increased. Thorp's analysis is also reflected through statistical data provided in the Colerain Fire – EMS *Master Plan 2001-2010,* and supports the need to expect and plan for the continued increase of EMS incidents and resources.

The prediction of paramedic transports increasing 50% suggests that in the next ten years paramedics will transport half of the incident responses. "Of the 5,060 emergency medical

incidents that occurred in 1998, the department experienced 1,429 occurrences of two or more ambulances O. O. S. providing victim care or transporting victims of emergency medical incidents. This represents 3,304 of the total incidents for the year" (Colerain Fire-EMS, 2000, p. 41).

The 2009 projected incident volume increase will directly relate to staffing issues for the department and require the need to re-allocate personnel and possibly cause the need to hire additional personnel to meet the projected demand. This is supported in an article in *EMS Insider Newsletter* stating,

> In our business, we have a very limited ability to raise revenue, and of the options that we explored to cut cost, the only one that got us even close to the need was the change in staffing configuration to an EMT/medic level. (Anonymous, 2001, p. 24)

The cost analysis comparison completed during the study was strictly based on personnel cost per year to staff units around the clock. Considering the facts that the apparatus resources have already been acquired and the alternative delivery models would not add any additional cost relative to equipment and training other than personnel cost, they would actually reduce cost with the elimination of two non-transport paramedic units.

It is difficult, if not impossible, to directly compare performance and cost-efficiency parameters between all BLS-ALS and an all ALS system. However, it is as important to recognize the potential strengths and weaknesses of each delivery model and consider the aspects of each model. Working through this process should assist in a model selection that best fits the organization. Regardless of the model selected, it should be understood that there would be successes and opportunities for improvement during the infancy and maturing stages. There must

be a process of implementation, evaluation, and modification that must become regimented to continue to meet the organizations mission of providing the highest quality EMS with the resources available to the department.

Browett suggest, "Where an EMS system bears additional cost associated with staffing a transport ambulance with ALS: ALS vs. ALS: BLS-D and there are a limited number of paramedics available for ALS vehicle coverage, we recommend the use of ALS: LS-D crew combinations" (1992, p. 15).

The research data suggest and supports the fact that the Colerain Fire – EMS is not sufficiently staffed to operate an all ALS system currently. The data also supports there are sufficient personnel to operate a combination BLS-ALS system.

> "From a quality-of-care perspective, it is possible that even if the ALS response might be delayed, more patients could be saved by the presence of highly skilled paramedics who will respond well to 95% of calls, particularly with today's availability of first responder defibrillation." (Mesesso, Pepe, Stout, 2000).

In most cases, Colerain Fire – EMS has the ability to deliver EMS personnel to most incidents within a four-minute response time for BLS incidents and ALS intervention within 8 minutes as suggested by the American Heart Association. The initial responding units have the capability of performing early defibrillation, which has been determined to be a life saving procedure, if identified early and applicable treatment protocols are applied.

According Morris in 1993, "Ambulances are staffed by BLS EMTs not paramedics, because analysis revealed that only 30% to 50% of our EMS dispatches resulted in a paramedic-level patient transport" (p. 42). In reviewing Colerain Fire – EMS statistics, it was identified that the paramedic transport rate is 30 %. This suggests that

70% of the incidents required BLS transport, which is directly proportional to Morris's findings. When staffing permits two paramedics on each first out ambulance at Stations 25 and 26, it will facilitate the need to cover the remaining two ambulances with a BLS-ALS combination unit. If a dispatch indicates an ALS incident, the engine company assigned to the station would respond to provide paramedic support as required by the department's medical director and standing protocol. Nordberg cites, "Some cities continue to fight to hold onto their two-paramedic system, while others have discovered that the one-plus-one system works just fine and is certainly better than having no paramedics at all" (Nordberg, 2000, p. 47). She also writes that,

> One reason for choosing that staffing pattern is that they just don't have enough paramedics in the system to fully staff each of their 36 engine companies over three shifts, he says. But their EMTs are more than able to support the paramedics in giving good patient care. (Nordberg, 2000, p. 50)

Anytime change is introduced in an organization it will disrupt the status quo or the routine way of doing business. The organization must consider other aspects and their potential impact to itself and customers to which it serves.

> Don't pass up an opportunity to commit your fire department to an expanding role in your community's EMS system. EMS has been good to those departments wise enough to take it on effectively.... With fire responses declining in many communities, our survival depends on finding and delivering other emergency services, such as EMS, hazmat [*sic*], and technical rescue. (Morris, 1993, p.43)

Another consideration that would directly impact emergency operations is EMS personnel burn out, morale problems, and skill retention issues. Vance has identified these issues by stating,

> The Laramie Fire Department combats these challenges to morale by rotating personnel through the ambulance duty. Each firefighter rotates between the duty ambulance and one of the suppression apparatus. In this way, no one group of firefighters is saddled with the responsibility of operating the ambulance all the time. The ambulance workload, roughly 75% of the total call volume, is shared by all firefighters (1999, p. 62).

Vance went on to explain that,

> The ALS pumper and ambulance duty rotation address another issue common to many fire-based ambulance services: skill retention. In services where personnel are assigned away from the ambulance for extended periods, their EMS skills inevitably deteriorate (1999, p. 66).

Currently, Colerain Fire – EMS's system delivery allows this concept to exist with personnel assigned to specific apparatus. If all engine companies functioned as paramedic engine companies, personnel would be exposed to EMS when assigned to fire apparatus. The paramedic engine companies would respond on specific protocol responses to assist BLS-ALS ambulances with patient care and apply ALS interventions, which provides an opportunity to exercise skills and maintain proficiencies.

Certainly, the community expects the fire department organization to deliver effective and efficient emergency medical services. In recognition of this fact, there are several significant implications for the Colerain Fire – EMS as a result of this research

project. First, the impact of the proposed alternative delivery model will be the increased EMS and fire-rescue incident responses. With the number of paramedic engine company EMS incidents increasing, the potential for missed fire incidents is a concern. This observation was noted by Morris in his 1993 article *15 Years of Paramedic Engines*,

> The "missed fire call" is another common concern. Each jurisdiction has a different level of fire activity, but national statistics indicate that most communities are experiencing fewer fires. A fire may be missed by the first due company because of a medical response, but the likelihood is very low. (p. 42)

Secondly, managing incidents with a limited a number of personnel will further complicate overall operations. During periods of staffing shortages and increased incident activity, the organizational culture supports the philosophy that personnel must always take first emergencies first. To compound this situation, response times and the need to request mutual aid are increased. It is often more palatable for the governing body and customer to accept the justification of a delayed response by a "first-due" engine company because that company was unavailable on another emergency incident.

Third, the fiscal impact on the organization is the increased cost of providing EMS service regardless of the model chosen. Although there will not be a significant fiscal savings with the proposed models. The benefit will be realized from the: (a) re-assignment of personnel; (b) elimination of capital resources; (c) operating expenses.

It is the author's opinion, based on the research reviewed, that the increased request for both fire and EMS incidents will directly impact the organization. The data clearly demonstrates that there are not enough paramedics to sufficiently staff an all "ALS" system. The data also determined that there are enough qualified EMTs and

paramedics to be effective in providing a combination "BLS-ALS" system that would satisfy the customer's needs in the future.

RECOMMENDATIONS

To improve the effectiveness and efficiency of the emergency medical service delivery by Colerain Fire – EMS to its customers, the following recommendations should be carefully considered:

1. To modify the current EMS delivery system to maximize staffing of personnel to meet the future incident demands through 2009.
2. To establish a process to evaluate fire and EMS demand including: (a) incident types; (b) response times; (b) geographical percentages; (c) ALS dispatches vs. ALS transports; (d) number of paramedics transporting the patient to a medical facility. This data should be shared and reviewed by department officers for analysis and delivery improvement.
3. To eliminate two non-transport paramedic units and re-allocate those personnel to a paramedic engine company and a fifth ambulance.
4. To designate Engines 25 and 26 as "paramedic/engine" companies. This can be accomplished by using the re-allocated personnel and equipment from the disbanded units to these engine companies without incurring the additional cost of new equipment and additional personnel. This will enable the department to provide five "ALS" equipped engine companies to first respond to incidents when no transport units are available and meet the response national standards.
5. To implement a recruitment and retention program specifically directed towards paramedics to identify shortcomings in staffing. Once this objective has been accomplished and a process is in place to cycle employees through the organization to maintain the necessary number of paramedics, the department will be able to move to the

next level of EMS delivery service by providing and all ALS system to the residents and visitors of the community.

6. To determine the effectives of the recruitments and retention program, an evaluation process measuring organizational paramedic levels and the end impact of emergency medical service delivery. Once the evaluation process has determined it effectiveness, then it is imperative to fund this program at an increased level so that the majority of the community will feel a significant impact.

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APPENDIX 1 – 2009 FIRE INCIDENT PROJECTIONS

Table 1

Year	Actual Number of Incidents	Forecast Number of Incidents	Actual Margin of Error	% Margin of Error	Lower Confidence Value	Upper Confidence Value
1990	1506					
1991	1499					
1992	1444					
1993	1761					
1994	1541	1790	49	3	1761	1852
1995	1821	1896	75	3	1866	1962
1996	2195	2003	-193	-9	1970	2073
1997	2141	2109	-33	-2	2075	2183
1998	2151	2216	67	3	2180	2293
1999	2265	2322	57	251.7	2285	2403
2000	2141	2429	287.5	13242.8	2390	2512
2001	2233	2535	302	1352.4	2494	2624
2002	2201	2642	440.5	2001.4	2599	2734
2003	2334	2748	414	1773.8	2704	2844
2004		2855			2809	2954
2005		2961			2914	3065
2006		3068			3018	3175
2007		3174			3123	3285
2008		3281			3228	3395
2009		3387			3333	3506

APPENDIX 2 – 2009 EMS INCIDENT PROJECTIONS

Table 2

Year	Actual Number of Incidents	Forecast Number of Incidents	Actual Margin of Error	% Margin of Error	Lower Confidence Value	Upper Confidence Value
1990	2958					
1991	3443					
1992	3246					
1993	3797					
1994	3850	3941	91	2	3878	4079
1995	3987	4173	186	5	4106	4319
1996	4322	4405	83	2	4335	4559
1997	4456	4637	181	4	4563	4799
1998	5060	4869	-191	-4	4791	5039
1999	5102	5101	-1	0.0	5019	5280
2000	5186	5333	147	2.8	5248	5520
2001	5344	5565	221	4.1	5476	5760
2002	5216	5797	581	11.1	5704	6000
2003	5627	6029	402	7.1	5933	6240
2004		6261			6161	6480
2005		6493			6389	6720
2006		6725			6617	6960
2007		6957			6846	7200
2008		7189			7074	7441
2009		7421			7302	7681

APPENDIX 3 – CURRENT PERSONNEL COST

Table 3

Colerain Fire and EMS Current Service Delivery Model (Brown Method)

Unit Type	Number of Units	Hourly Cost	Annual Cost
BLS Transport	4	$23.95	$839,208.00
ALS Unit	2	$26.82	$469,886.40
		Total:	$1,309,094.40

Table 4

Colerain Fire and EMS Current Service Delivery Model (Silvati Method)

Quantity & Unit Type	Part-time Personnel	Career Personnel	Avg. Hourly Cost	Annual Cost
4 - BLS Transports	8	-	$12.31	$862,684.80
2 - ALS Non-transport	2	0	$12.31	$215,671.20
	-	2	$19.38	$339,537.60
			Total:	$1,417,893.60

APPENDIX 4 – 2009 BLS-ALS PROJECTED PERSONNEL COST

Table 5

Colerain Fire and EMS 2009 Projected BLS-ALS Service Delivery Model Costs (Brown Method)

Unit Type	Number of Units	Hourly Cost	Annual Cost
BLS-ALS Transport	5	$30.31	$1,327,578.00
		Total:	$1,327,578.00

Note: The 2009 projected cost is based on a 3% average per year increase.

Table 6

Colerain Fire and EMS 2009 BLS-ALS Projected Service Delivery Model Cost (Silvati Method)

Quantity & Unit Type	Part-time Personnel	Career Personnel	Avg. Hourly Cost	Annual Cost
5 – BLS-ALS Transports	5	-	$13.49	$606,630.00
	0	5	$22.38	$980,244.00
			Total	$ 1,586,874.00

Note: The 2009 projected cost is based on a 3% average per year increase.

APPENDIX 5 – 2009 ALL ALS PROJECTED PERSONNEL COST

Table 7

Colerain Fire and EMS 2009 Projected BLS-ALS Service Delivery Model Costs (Brown Method)

Unit Type	Number of Units	Hourly Cost	Annual Cost
ALS Transport	5	$32.02	$1,402,476.00
		Total:	$1,402,476.00

Note: The 2009 projected cost is based on a 3% average per year increase.

Table 8

Colerain Fire and EMS 2009 All ALS Projected Service Delivery Model Cost (Silvati Method)

Quantity & Unit Type	Part-time Personnel	Career Personnel	Avg. Hourly Cost	Annual Cost
5 - ALS Transports	5	-	$15.49	$678,462.00
	0	5	$22.38	$980,244.00
			Total	$ 1,658,706.00

Note: The 2009 projected cost is based on a 3% average per year increase.

APPENDIX 6 – 2009 PROJECTED STAFFING

Table 9

2009 projected unit day minimum staffing requirements for BLS-ALS system

	Unit 1	Unit 2	Unit 3
Career paramedics*	10	10	10
Part-time EMTs*	5	5	5
Total	15	15	15

Note: * *Officers were excluded in the EMS staffing.*

Table 10

2009 projected unit day minimum staffing requirements for all ALS system

	Unit 1	Unit 2	Unit 3
Career paramedics*	10	10	10
Part-time paramedics*	5	5	5
Total	15	15	15

Note: * *Officers were excluded in the EMS staffing.*