Feasibility and Effectiveness of a Quick Response Vehicle for Medical Emergencies in the City of Winston-Salem

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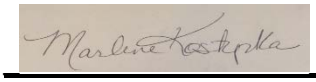
CERTIFICATION STATEMENT

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

Signed: 

Abstract

The City of Winston-Salem has always found solutions to continue to provide services to its community regardless of its economic status. The problem is that the Winston-Salem Fire Department (WSFD) utilizes traditional frontline fire apparatus as the primary emergency response for all EMS calls. The purpose of the research was to identify if dispatching a quick response vehicle (QRV) is feasible and more effective than a fire apparatus to EMS calls in the City of Winston-Salem.

Descriptive research was used to answer (1) Is there a reduction in turnout and travel times when utilizing a QRV to respond to medical emergencies instead of a fire apparatus? (2) What types of medical emergencies should a QRV be deployed to? (3) What are the cost savings, if any, by using a QRV instead of a fire apparatus for response to medical emergencies?

The research procedure began with literature review and data collection from magazines, journals, and web-based sources. A survey was delivered nation-wide to departments that currently use a QRV for medical responses. Data from Forsyth County Emergency Medical Services (FCEMS), WSFD medical responses, and data collected from a one month-QRV trial program conducted by the WSFD in 2007, were analyzed.

The results of this research determined response time is only effective on high- acuity class, such as cardiac arrest, stroke, major trauma, choking. Several problems within the WSFD will need to be addressed prior to the implementation of a QRV program. Recommendations from this research included the creation of a new team, to work with the community to identify expectations and to create a community driven strategic plan. Also, allowing the WSFD more ownership within the communications center, having the ability to make changes to unit recommendations as necessary, and having medical calls dispatched from the same PSAP.

Table of Contents

Introduction

Since 2008, economic declines have plagued municipal organizations resulting in less financial capital to pay for salaries and services traditionally provided to the communities they serve. This has required many fire service leaders to rethink and reconsider the way core services are delivered. Layoffs and reduction in service have occurred as a result of the economic downfall. The City of Winston-Salem has not been exempt from these threats, and continues to seek alternative opportunities for the sustainment of service to the community, while operating within the budget available. The problem is that the Winston-Salem Fire Department (WSFD) utilizes traditional frontline fire apparatus as the primary emergency response for all EMS calls. No assessment has been completed to determine the cost or effectiveness of this approach. The purpose of the research was to identify if dispatching a quick response vehicle (QRV) is feasible and more effective than a fire apparatus to EMS calls in the City of Winston-Salem.

Descriptive methodologies were utilized to complete this research. The research questions are as follows: 1) Is there a reduction in turnout and travel times when utilizing a QRV to respond to medical emergencies instead of a fire apparatus? This question was intended to determine if response time differences exist when responding with a QRV in place of a fire apparatus. 2) What types of medical emergencies should a QRV be deployed to? This question was posed to determine if the WSFD is sending the right resources to the medical calls. The final research question 3) What are the cost savings, if any, by using a QRV instead of a fire apparatus for response to medical emergencies? This question is important because the WSFD is facing budget cuts, forcing an evaluation to look at new ways to provide the same level of services to the community. It is important to analyze the data in Winston-Salem, and not to make

assumptions based on models use by other fire service agencies.

Background and Significance

The City of Winston-Salem is the fifth largest city in North Carolina, and is a richly historic community encompassing 134 square miles. Between the 2000 and 2010 census, the City of Winston-Salem grew by 23.6%, with an additional 5% growth of into 2015. According to Census Data (2015), the City of Winston-Salem has 2,412,218 citizens, with a population density of 1,800 people per sq. mile, with nearly a quarter of the population under the age of eighteen. The city's population is diverse, with 34.7% African American, and 15% Hispanic (Census Data 2015).

Winston-Salem is an urban city that is home to five colleges and universities, three state-of-the-art hospitals, and historical landmarks dating back to 1766. It is also home to the tallest office buildings in the region. US 52 runs north and south through the city, and Interstate 40 runs alongside downtown Winston-Salem, with Business 40 bisecting downtown.

The term "doing more with less" has become a common phrase among those in circles of city government. The cost of "doing business" has escalated dramatically over the past few decades. Whether prices at the pump, or the rising cost of health insurance, individuals have seen this affect their bottom line. Municipal governments have not been immune to these same cost factors. In these challenging economic times, one thing is for sure: The people have not reduced their expectations of service. The mission of the City of Winston-Salem is, "The City of Winston-Salem provides quality, affordable services that ensure the health, safety and well-being of citizens, while collaborating throughout the community to ensure its economic, social and environmental vitality" (City of Winston-Salem City Government, (n.d). As a result of fiscal and economic challenges, local government must rethink what services are being provided, and

perhaps more importantly, how those services may be provided with decreasing budgets. The 2016-2017 annual budget for the WSFD was $29,227,140.00 (City of Winston-Salem, 2017 p.3), which included the operational budget and capital forecasts.

The WSFD is a full service, career urban fire department which formed in 1913 by merging the Salem (established 1772) and Winston departments. In 1999, the department began responding to medical calls and in 2003 started using an electronic report management system. Firefighters responded to 26,521 emergencies in FY 2016-2017, which included fires, medical emergencies including those requiring advanced life support, hazardous materials, and rescue incidents. Medical calls represent 16,891, or 64%, of the responses. Fire apparatus, which have a variable price range depending upon apparatus class – $400,000 to $500,000 for a traditional pumper truck, to $750,000 to $900,000 for a ladder truck, currently respond to the medical emergencies upon dispatch from the Forsyth County Emergency Medical Service (FCEMS) after a telecommunicator processes the calls.

The fire department strives to comply with the benchmarks established by the National Fire Protection Agency (NFPA) 1710, *Standard for the Organization and Deployment of the Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, and the guidelines established by the Insurance Service Office (ISO). To provide optimal service, nineteen fire stations are strategically located within the city limits with the goal of responding to emergencies in four-minutes or less. The WSFD staffs eighteen engines companies, five ladder companies, and one rescue company. The WSFD also has two HAZMAT response units, along with a decontamination unit. The administrative staff consists of a Fire Chief, four Assistant Fire Chiefs, three shift Division Chiefs, nine Battalion Chiefs, and a Fire and Life Safety Division. The goal of this research is to identify if having

QRV is effective and feasible in the future of the WSFD.

The first goal in the USFA's strategic plan is: "Promote Response, Local Planning, and Preparedness for all Hazards" (U.S. Fire Administration [USFA], 2014, p.9). A more analytical approach to decision making will enable the Fire Chief and the city's administration to make informed decisions. This will ultimately result in achieving the above goal. This research also aligns with the Executive Analysis of Community Risk Reduction of the Executive Fire Officer Program (EFOP Year #2), "Focus on Reducing Risk in the Local Community (p.ix)." The class encourages the fostering of new ideas to prevent the risk of emergencies in the community. We have not completed a root cause analysis or analyzed response models for medical response in over 13 years. There has been an emphasis on community risk reduction (CRR) since the first America Burning was published, but the fire industry has taken on more roles since the recession (USFA, 2015). The fire industry must now prepare to offer CRR in all areas fire, medical, rescue, and HazMat. The adoption of an all-hazards model where fire apparatus respond for all emergencies may not always prove to be the safest and most cost-effective.

Literature Review

A literature review was conducted through a search of professional magazines, journals, and web-based sources to produce results that provide answers the research questions posed. The fire service considers itself an all-hazard response business. While all-hazard sounds like a proven concept, using a risk-based approach to planning, coupled with functional and prioritized contingency planning, makes the best possible use of limited resources (Canton, 2013). It is important to ensure that the right resource is sent to the right type of call rather than continuing to send everyone all the time. Decreases reliability of fire apparatus, with the increase of emergency calls a crossed the country, is forcing the fire service to find ways to provide both

medical and fire needs simultaneously. NFPA releases semi-annual statistical surveys of the nation's fire departments. In their *U.S Fire Department Profile 2014, NFPA* (2016) characterized 61% of all fire departments as offering some level of EMS provision either basic and/or advanced life support. The NFPA has also published an annual statistical data on fire department call breakdown since 1980. Their data indicates that over the last 33 years (1980 to 2013) fire- related calls have dropped 58% (from 2,988,000 to 1,244,000) while EMS-related calls have grown 324% (from 5,045,000 to 21,372,000) (NFPA, 2014).

Response Times

For decades the fire service has responded to medical emergencies with the understanding that the strategic distribution of stations allows for a quicker response time and a better outcome for the patient. The fire service's "menu" of services has changed over time because of the changing needs of the community, and the fire department was best positioned and capable of providing the services to meet those needs (Wallace, 2014). In recent years, many industry leaders have begun to question the benefit of measuring and evaluating systems based only on response times. Shaving seconds or even minutes off response times seems to benefit only a small subset of clinical conditions ("Should Response Time Be a Performance Indicator?" 2015).

The multiple variables required for an accurate response time assessment for total response time for an emergency can be difficult to capture, requiring the accurate collection of the time the call was received in the PSAP, call processing time, turnout time of the apparatus, response time, and time to patient contact, are all components needed to be collected in a standardized manner. Time is easy to measure—response times are not. There is still no universally accepted definition of response time that utilizes the same "start-the-clock" and

"stop-the-clock" criteria ("Should Response Time Be a Performance Indicator?" 2015).

There is not a federal law regarding response time. Response time recommended by NFPA 1710, _5.3.3.4.2, requires communities to "provide for the arrival of an ALS company within an eight-minute response time to 90% of incidents" the NFPA standard excludes call-processing time intervals (NFPA, 2007). In addition, a recent survey of the 200 most populous cities in America found that more than three-quarters (77%) of the survey respondents report a target of 8:59 or less using the fractile measurement method ("EMS Response Time Standards," 2004).

Typically, it is a contractual agreement between EMS providers and communities. This standard, which is developed by community expectations, is what drives the response time minimal performance or safety standards. Compliance is sometimes voluntary or mandatory, regardless EMS agencies must consider the impact of "voluntary" standards on private litigation. In some states, a department may be liable for negligent performance ("EMS Response Time Standards," 2004). Some communities have been willing to pay additional costs of having short response times but now feel compelled to reassess because of budget restraints. Stakeholders must be educated that sending the correct type of help, which is able to manage the patient's needs within a reasonable time frame, may be more important than considering response times as the primary measure of performance.

Meeting public expectations should be weighed against available resources and the ultimate good of the community. For fire service agencies providing medical response need to effectively convey the message that faster doesn't always mean better, they must open an ongoing dialogue with their communities. Agencies need to communicate what quality is in medical care and how it can be obtained. Programs that can lead to better outcomes include a

robust first responder system utilizing current police and fire resources; public education on how to identify strokes and heart attacks and when to call 9-1-1; and community-wide education and buy-in to develop a public-access CPR and AED program (“Should Response Time Be a Performance Indicator?” 2015)

As we move into the future, more concentration should be placed on patient outcomes, patient satisfaction, and transporting patients where they need to go for the best care. With that said, the clock is always going to be a factor in the fire service. An analysis of medical responses and specific response -time standard needs to be identified.

Type of Medical Emergencies

Ensuring that cost effective measures are utilized when responding to medical emergencies is vital to budget restraints. Placing too much emphasis on response times and not analyzing the outcome is not cost effective. Emphasis on response time may have unintended consequences such as more motor vehicle crashes and skill degradation when increasing the number of paramedics answering a finite number of calls (“Should Response Time Be a Performance Indicator?”2015).

Fire departments and EMS can offer quality primary care in many out-of-hospital settings and in coordination with other healthcare institutions. Both EMS and healthcare experts are looking to improve patient care outcomes and reduce healthcare system costs. Prehospital care and positives outcomes for specific conditions have demonstrated positive outcomes (Hagan, 2009). Research has shown that with the exception of high-acuity calls such as cardiac arrest, myocardial infarction, stroke, airway obstruction and severe trauma, the majority of calls to which EMS is dispatched aren’t as time-sensitive and don’t show better outcomes with a more rapid response. (“Should Response Time Be a Performance Indicator?’”2015).

There is an estimated 500,000 ST-segment elevation myocardial infarction (STEMI) events in the U. S. annually (Hagan, 2009). This is a classic heart attack and can be identified by evaluating the heart using an electrocardiogram (ECG). Integrated EMS systems and early notification to the hospital of the results have proven to play a key role in improving the STEMI outcome. Research shows an approximate 10-minute decrease in the door to drug time and 15-20-minute decrease in door-to-balloon time for a patient using the EMS system compared to patients arriving at the ED on their own (Hagan, 2009).

Automatic External Defibrillation (AED) carried by first responders has played an important role in survival. Defibrillation immediately after witnessed cardiac arrest results in survival rates as high as 90%. Each minute that the heart remains in fibrillation results in a decrease in survival of approximately 10% (Hagan, 2009). Although, long response times and prolonged transport times do not improve survival rates. The overall contribution of defibrillation to survival from sudden cardiac arrest depends upon the efficiency of the chain of survival of the overall EMS system (Hagan, 2009).

Strokes are classified as a cardiovascular disease. It is important that first responders recognize the signs and symptoms of a stroke. Each year, about 795,000 Americans have either a new or recurrent stroke. Every 40 seconds, someone in this country suffers a stroke. Stroke kills more than 137,000 people each year; every four minutes someone in the U.S. dies from a stroke (Maggiore, 2012). Although there is a need for a quick response, there are numerous risks factors associated for stroke. Including hypertension, age, elevated serum cholesterol, smoking, diabetes and most notably, elevated body mass index (BMI) and the “obesity epidemic” (Maggiore, 2012). Upon the arrival of the first responders it is important to identify if stroke symptoms are present. As with all prehospital patients, assessment of the airway, breathing and

circulatory status are essential. Every minute of delay to treatment is said to cost a patient 1.9 million brain cells (Maggiore, 2012). The EMS community plays a large role in providing a quick response, identification of a stroke patient, transport and early notification to a hospital. They can also educate the community on stroke awareness and prevention. Strokes are costly and create financial and emotional burdens on a family member. Thus, reduction of the frequency and severity of stroke by preventive measures is essential to avoid the natural trend of increasing the human, economic and social burden of stroke (Maggiore, 2012).

Cost

Charles Grimes of Ferrara Fire Apparatus reports that per-mile costs for fire equipment depend on their use and the quality and regularity of maintenance, with the average routine and preventative maintenance costs for fire engines being $4,500 (Rowe, 2009). The public increasingly asks why an expensive fire apparatus races across the city when there's clearly no fire. Fuel consumption and diesel emissions have become carbon footprint issues. Most engines, ladder trucks, and other large vehicles such as heavy rescues, get anywhere from three to five miles per gallon of fuel and an idling fire engine uses two gallons of diesel fuel every thirty minutes. According, to calculations from Arlington Texas, the Chevy Suburban gets 10-12 miles per gallon of gasoline while the fire apparatus gets 3.6 miles per gallon of diesel (Cournoyer, 2011).

The emissions generated from these tasks by cities all over the United States contribute to the fact that each year vehicles in this country consume more diesel fuel and gasoline – without moving. The time spent idling appears counterproductive as needless carcinogenic emissions are introduced into the environment, especially at medical calls ("Idle-Reduction Technology Can Produce Fire Service Benefits", 2010). Fire departments to evaluate the manner in which they

operate their fleet on emergency and non-emergent. Fifteen or twenty years ago, it would not be uncommon for a fire pumper to be in service for twenty to twenty-five years. This same piece of equipment would accumulate about 50,000 miles in a twenty-year span. Trucks did not leave the stations except to respond to fire calls, to fuel, or to train. Today, with the introduction of fire-based EMS, trucks are on the road more and can easily accumulate 10,000 – 15,000 miles a year (Drake, 2005).

In 2014, Portland (OR), placed a QRV program into place. The department identified low-acuity calls where a patient was not in danger of dying and responded with a QRV staffed with firefighters off of an existing engine. The department decided that a two-person rescue response would make sense for those low-acuity EMS calls. The plan was that by doing so, we could create more efficient response times with the other pumpers and trucks because they wouldn't be tied up with the low-acuity calls (Peterillo, 2014). During the six-month evaluation process, the Portland, has saved approximately $2,000. Some of this cost is attributed to tires and brakes, a pumper will wear out a set of brakes after 15,000 to 17,000 miles and a bit more in mileage for a set of tires (Peterillo, 2014).

Summary

The broad spectrum of literature review in this portion of the project provided compressive perspective as to answering the research questions. The literature review revealed a lack of research on the difference between total response time of a fire apparatus and a QRV. The literature highlighted that response times should not be the only determining factor or reason for implementing a QRV. The research showed that public perception is more important than response times on most medical calls. A decrease in total response time produces better outcomes but only produce positive results in high-acuity medical emergencies.

There was an abundance of information on prehospital care and positives outcomes for specific conditions such as cardiac arrest, myocardial infarction, stroke, airway obstruction, severe trauma, and the importance of early defibrillation from an AED. Majority of the request for medical service aren't as time-sensitive and don't show better outcomes with a more rapid response. The literature review identified the importance of sending the right resources needed for a medical emergency. This analysis will help the WSFD to determine which medical calls are in need of a quick response and which ones are not. Which can have a direct impact on the cost for medical services where a fire apparatus is being sent to and are not needed. The data gathered will be analyzed to determine the difference in operating cost between a Tahoe and a fire apparatus within the WSFD. It is important to analyze the data in Winston-Salem, and not to make assumptions based on other fire departments models.

Procedures

This applied research project began with a literature review and data collection from journals and internet articles. With any type of research, the procedure is the foundation and formulates the basis of replication and validity. This research project harnessed the same desired to discover effective delivery methods for medical calls by the WSFD. A descriptive research method was used for this paper to answer research questions and to study workable resolutions to the problem identified: The Winston-Salem Fire Department (WSFD) utilizes traditional frontline fire apparatus as the primary emergency response for all EMS calls. The desired outcome of this research was to discover if a QRV is feasible and would be effective in the City of Winston-Salem and to reach a conclusion, three research questions were developed that would aid in meeting the goals of this proposal.

- *Is there a reduction in response times between a quick response vehicle and fire*

apparatus responding to medical calls?

- *What types of medical emergencies should a QRV be deployed on?*
- *What are the cost savings, if any, when a quick response vehicle is deployed instead of a fire apparatus to medical calls?*

To answer the first question, the author of this applied research project surveyed a selected group of departments throughout the county who are currently using a QRV (see Appendix A). This survey helps the researcher gain a better understand if other departments were able to see a reduction in total response times. An analysis of response times during a one-month trial (November 13, 2007, till December 11, 2007) of a QRV within the WSFD and using the same time period of current response times was completed (see Appendix B). This provided information on response time difference within the WSFD and limited information on reliability.

To answer which medical emergencies a QRV should respond to, the author used the same survey to gain a better understanding of deployment and staffing models used across the country. An analysis of six-months of emergency medical calls from FCEMS was performed to determine if the chief complaint of the patient obtained by the 9-1-1 dispatcher was the same as the paramedic found upon arrival (see Appendix C).

Determining cost savings, if any, when a quick response vehicle is deployed instead of a fire apparatus to medical calls, information was gathered from the WSFD maintenance shop and the records management system to analyze the cost of annual maintenance, labor, and the cost of fuel for fire apparatus and the Chevy Tahoe battalion chief's vehicles (see Appendix D). In order to determine if there was a cost saving, Engine Four and a Battalion Chief vehicle were compared against each other. The total miles and gallons of fuel used were obtained to determine how many miles per gallon of fuel each vehicle is getting. The total number of calls

that were responded to by Engine Four was divided by the number of medical calls that engine responded to was used to calculate the percentage of medical calls. This was used to determine the number of miles that was placed on the apparatus for medical responses. The miles were multiplied by the national average for gas in North Carolina, which provided an estimated gas cost. The same theory was used to determine fuel cost for the apparatus to respond to medical calls. This number was then subtracted from the annual fuel cost the apparatus used in FY 16-17.

Further Procedures Detailed

Information concerning response times, peak times, types of medical calls, apparatus fuel cost, equipment cost and apparatus cost was gained by the WSFD records management system, CAD, and Forsyth County Communications Center. The data was scrutinized as to the relating specifically to the topic. The 6th edition of the American Psychological Association's Publication (APA) Manuel was consulted to provide uniform documentation of all citations, references, structure, and punctuation of this research study in the preferred format. All of the data was analyzed by the home territory of an apparatus as opposed to looking at specific engine company responses.

One survey instrument was generated and distributed named "EMS Response Deployment." It was constructed using google docs: https://drive.google.com/open?id=1wjD5UJvsNRLyCIqNLKxW_O_pk1nfBNbCE9-P6auQbUo The survey consists of 14 questions (see Appendix A) which was a combination of "fill in the blank options", multiple choice and "yes/no". The questions posed to survey participants were as follows:

1. *Email address*
    - This fill in the blank question was chosen simply to have contact

information for follow-up questions if needed.

2. *Name of Fire Department and state*
    - This fill in the blank question was chosen to identify which states are participating in a QRV program and to analyze the difference between states.
3. *The number of medical calls annually?*
    - This fill in the blank question was chosen to identify departments that are "like size" in regards to emergency medical responses.
4. *What is the authorized staffing of the department?*
    - This fill in the blank question was chosen to analyze the difference between departments that have a QRV response and the current staffing model in the WSFD.
5. *Total population served?*
    - This fill in the blank question was chosen to analyze population difference between agencies that responded to the survey. It was also asked to identify if there is a trend between population and QRV's.
6. *How long has the department been providing a quick response vehicle (QRV) for medical response?*
    - This fill in the blank question was requested to determine if the department has been established long enough to provide relevant responses.
7. *What type of vehicle is being used?*
    - This fill in the blank question was requested to determine if the type of

vehicle produces different cost savings.

8. *What is the staffing model?*
    - This fill in the blank question was chosen to determine how the agency was utilizing the QRV and to analyze the different types of staffing models provided.
9. *Is the QRV used during peak hours only? Yes/No*
    - This “yes/no” question explores how agencies are utilizing the QRV.
10. *Has the department seen a reduction in total response time? Yes/No*
    - This “yes/no” question attempted to identify if a QRV responding to medical calls has a reduction in total response time. Further, analyze if the cost vs. response time to determine if there is no cost difference, would the total response time difference prove to be sufficient enough to support the need for a QRV.
11. *If "yes “please provide information on the total response reduction?*
    - This question was chosen as a follow-up to determine the actual total response reduction if any.
12. *What type of emergencies does the QRV respond to?*
    - This fill in the blank question was chosen to analyze what type of calls a QRV is responding to across the country.
13. *What is the staffing model of the QRV?*
    - This fill in the blank question was chosen to analyze the different types of staffing models that are used. It will also be used to determine if one of the staffing models will be successful in the WSFD.

14. *Please provide any information on cost savings of a QRV?*

- This fill in the blank question was an offering for the surveying department, who answered the questions, the opportunity to share if they have seen cost savings and how they determined the savings. It also provided an opportunity for the department to share any information they have gathered about a QRV response.

Assumptions and Limitations

The literature review identified that the fire service has identified the need to find cost effective ways to conduct business. Limited literature information on QRV's created a challenge determining if they can influence outcomes and if they are cost effective. Each department that responded to the survey identified how QRV's is utilized in their departments and if there is a reduction in turnout time. A QRV deployment model was tested in 2007 and analyzed against current data, to determine if a reduction in response time could be determined. However, the data is ten years old. The literature review identified NFPA 1710, is the only standard for response times regarding fire service apparatus. If the governing body has not adopted the standard, the public perception is the only standard required. A limitation of the survey was that departments were identified through word of mouth and a local networking group which only provided 16 department responses, which does not reflect a true percentage of actual departments using QRV's. The limited number of responses to the survey narrowed the data on QRV deployment. The author had to use data to determine a defined percentage of calls an engine company responded to determine how many miles were placed on the apparatus for medical response. This information, it only provides an estimate of miles and not an exact number of miles. Data from the WSFD is only as good as the individuals entering it into the system. There

has not been training on the importance of report writing or data gathering in 14 years. The intent of this data was to determine if the QRV response would decrease total response time and if there were any cost savings between the tradition response of a fire apparatus and a QRV response.

Results

The utilization of descriptive methodology was the guide to discovery of information. The results of the three research questions were synthesized through a literature review. An analysis of a month-long trial period of a QRV program and response times were compared to the same time period in 2017 without a squad (see Appendix B). A survey was also sent externally to departments that are utilizing a QRV to respond to medical calls. (see Appendix A). Fuel cost, total medical emergency responses (see Appendix C), mileage, annual maintenance was gathered from the WSFD records management system, fleet maintenance, and the fire department maintenance shop (see Appendix D).

Research question one asked if there is a reduction in response times between a quick response vehicle and fire apparatus responding to medical calls. For the purpose of this an analysis of data from a one-month QRV trial and current deployment of the WSFD was examined. (see Appendix B). In November of 2007, WSFD implemented a QRV for the response of medical calls in the downtown area within the City of Winston-Salem. The QRV was located at Station One. Therefore, the QRV had a much higher response to medical call and a better total response to call in Home Territory One (see Table 1). A home territory is often referred to as a station response area. During the one-month trial, the QRV responded to a total of 129 medical emergencies. The author examined the Home Territories of Station One, Station Three, Station Four, and Station Six, this was the areas of higher call volume when the QRV was

in place. It continues to be the area of high medical response area to date. With the biggest increase identified in home territory six.

Table 1

QRV responses per home territory

Home Territory	QRV Responses	Request for medical service 2007	Request for medical service 2017
One	90	147	108
Three	30	91	87
Four	55	113	114
Six	35	74	107

The author determined that in relation to a reduction of response time, Home Territory One had the largest reduction. The reduction was 1 minute and 59 seconds (see Table 2). There are two theories that should be examined with this reduction. The first, the QRV was located in Home Territory One, therefore travel time is reduced for these emergencies. The second is that the QRV responded to 210 medical emergencies and 42.8% were located in Home Territory One. This data should not be excluded because Station One is centrally located in the downtown area, it is the second largest areas for medical emergency calls, and one of the stations that would get a QRV if proven feasible and effective.

The largest medical response area is Home Territory Four and it borders Home Territory One. This home territory is also the busiest overall and responds to 10% of the departments calls as a first-in unit. There was a 1 minute and 28-second reduction in time and during the trial period, the QRV responded to 26.2% of its class in home territory four. Approximately, 57.1% of the request for service in this home territory is for medical care. This author has come to the

conclusion that 1 minute and 28 seconds is a significant reduction when responding a cardiac arrest. For each minute that passes, it is calculated that the chances of survival decrease by ten percent ("Cardiac Arrest-A fight against time," 2016). A QRV will also add to the increase of reliability for Home Territory Four, due to the population high density and call volume.

Table 2

Difference in Response Times between a QRV and Fire Apparatus

Home Territory	Difference in Response Time
One	1:59
Three	1:05
Four	1:28
Six	0:22

Home territory Three also had a significant reduction in response time, while Home Territory Six showed a minimal reduction in time. However, Home Territory Six had the largest increase in medical responses between the two years studied. In regards to response time, a QRV would need to be located in Home Territory Six to have an effective reduction in response time. The literature review in combination with the data from WSFD concludes that response time is not a critical factor of positive outcomes in the majority of medical calls. Shaving seconds or even minutes off response times seems to benefit only a small subset of clinical conditions ("Should Response Time Be a Performance Indicator?" 2015).

Within the home territories studied there was an overall reduction of 4 minutes and 14 seconds, but the home territory where the QRV was located saw nearly a two-minute reduction in time. The average response time was between 2 minutes and 52seconds and 4 minutes 23 seconds, well within the recommended NFPA 1710 response time. In addition, a recent survey of the 200 most populous cities in America found that more than three-quarters (77%) of the survey

respondents report a target of 8:59 or less using the fractile measurement method ("EMS Response Time Standards," 2014).

According to the survey instrument (see Appendix A), five out of the sixteen departments using a QRV reported a decrease in response time. The largest reduction was a decrease from a nine-minute average to a three-minute average. The other four departments that reported a decrease had a response of still determining a difference to a one -minute decrease. This corresponds with the minimal differences seen in WSFD. It is important to educate citizens that sending the correct type of help, which is able to manage the patient's needs within a reasonable time frame, may be more important than considering response times as the primary measure of performance. Emphasis on response time may have unintended consequences such as more motor vehicle crashes and skill degradation when increasing the number of paramedics answering a finite number of calls ("Should Response Time Be a Performance Indicator?" 2015).

To answer research question two, the researcher used information from the literature review and survey results. WSFD responds to medical emergencies at the request of Forsyth County, after the telecommunicator performs an emergency medical dispatch (EMD) procedure. In FY 2016-2017 the WSFD responded to 17,631 medical emergencies and arrived prior to the ambulance 66.8% of the time. However, the WSFD only reported performing cardiac pulmonary resuscitation (CPR) 152 times. Many studies note the role of time and the delivery of early defibrillation in patient survival due to heart attacks and cardiac arrest, which are the most time-critical, resource-intensive medical emergency events to which fire departments respond (McCallion, 2012).

An analysis of Forsyth County Emergency Services (FCEMS) call records (July 2016-December 2016), indicated that 62% of the calls an ambulance responds to, the person who is

calling 911 for help and the paramedic, described the medical emergency the same (see Appendix C). This indicates that if a patient is in cardiac arrest, has severe trauma, or is having a stroke it was identified by the patient. Therefore, the dispatcher can send the right resources on emergencies. The dispatcher can send a QRV on the emergencies where time is of the essence and request a fire apparatus on medical calls where response time is not as important. Research has shown that with the exception of high-acuity calls such as cardiac arrest, myocardial infarction, stroke, airway obstruction and severe trauma, the majority of calls to which EMS is dispatched aren't as time-sensitive and don't show better outcomes with a more rapid response ("Should Response Time Be a Performance Indicator?" 2015).

Home Territory One has a request for medical service 1,566 times and Home Territory Four provided 1,640 requests for medical service. Results from FCEMS data indicate that of the 11,598 reportable responses studied, 13.59% of the request for service is actually for cardiac or breathing issues (See Table 3).

Table 3

FCEMS Response (July 2016-December 2016)

Type of Emergency	Number of Responses	Percentage
Cardiac	390	29.73 %
STEMI	7	.06%
Obvious Death	42	.36%
Respiratory Distress	1063	9.16%
Respiratory Arrest	9	.07%
Stroke	66	.57%
Total	1577	13.59%

The survey results indicate that the QRV concept is utilized for medical response more than any other response. Although, a QRV can also be used on vehicle accidents which often times turn into a medical request and to help meet the effective response force (ERF) on a confirmed structure fire or providing, medical rehab to firefighters and victims. Fifteen of the sixteen departments that responded to the survey are using QRV's to answer all medical calls, nine of the departments dispatch a QRV on confirmed structure fires (See Table 4). All of the department's staff the QRV with two firefighters and two departments have paramedics on the QRV.

Table 4

Survey Responses

Type of Emergency	QRV dispatched from survey
Medical	15
Confirmed structure fires	9
Vehicle accidents with minor injuries	4

The mission of the City of Winston-Salem is "The City of Winston-Salem provides quality, affordable services that ensure the health, safety and well-being of citizens, while collaborating throughout the community to ensure its economic, social and environmental vitality" (City of Winston-Salem City Government, (n.d.). To answer question three: What are the cost savings, if any, when a quick response vehicle is deployed instead of a fire apparatus to medical calls?

In FY 2016-2017 the WSFD responded to 17,631 medical emergencies using a fire apparatus. The WSFD arrived before the ambulance 66% of the time, but only reported performing CPR 152 times or 0.86% percent of the time on a medical call. The WSFD does not provide transport of patients and does not bill for any response service. The money for providing

medical services is budgeted in the fire departments overall budget. The 2016-2017 annual budget of the WSFD was $29,227,140.00 (City of Winston-Salem, 2017 p.3), which included operational budget and capital budget forecasts.

Engines responded to medical calls for serious injuries, life-threatening emergencies, extra hands, utilizing valuable expensive resources, leaving home territories unreliable for other calls that have an immediate need. Charles Grimes of Ferrara Fire Apparatus reports that per-mile costs for fire equipment depend on their use and the quality and regularity of maintenance, with the average routine and preventative maintenance costs for fire engines being $4,500 (Rowe, 2016). The WSFD will spend on average $8,871.64 on annual apparatus maintained and fuel over a five year period for a single apparatus. The annual average five year maintenance for a Tahoe after purchase is $2,331.01. However, additional personnel are needed to staff the QRV, this inflates the cost to $120,944.04 on average during the same five year period (see Appendix D).

Discussion

The results compared to the findings of others discussed in the literature review found some consistencies. For years the fire service has been educating the community on the need for quicker response times. Consensus standards are developed by specific industries to set forth widely accepted benchmarks for things such as response times. This is an attempt by the EMS industry to self-regulate by establishing minimal operating performance or safety standards (“EMS Response Time Standards.” 2004). There is not a federal law regarding response time. Response time recommended by NFPA when adjusted to include call-processing time. NFPA 1710, _5.3.3.4.2, requires communities to "provide for the arrival of an ALS company within an eight-minute response time to 90% of incidents" (the NFPA standard excludes call-processing

time intervals). However, recommendation needs to be adopted by the local government.

In November of 2007, WSFD implemented a QRV for the response of medical calls in the downtown area within the City of Winston-Salem. The QRV was located at Station One and a decrease in response time was 1 minute 59 seconds, in that territory. The location of the QRV will have to be located near the demand for medical responses, in order to see to gain the largest decrease in response time. In 2013, a faculty-led research team for Portland State University's Center for Public Service learned of one jurisdiction they studied had strategically purchased a three-bedroom house in a high 911-call generating area near a nursing home for an ambulance and its crew (Keisling, 2015). With the increasing number of medical responses, pre-positioned ambulances or QRV's can provide a lower response time to medical emergencies. Although in recent years, many industry leaders have begun to question the benefit of measuring and evaluating systems based only on response times. Shaving seconds or even minutes off response times seems to benefit only a small subset of clinical conditions ("Should Response Time Be a Performance Indicator?" 2015).

The WSFD reported performing CPR on patients152 times, this equates less than 1% of medical calls in FY 16-17 (WSFD RMS). Automatic External Defibrillation (AED) carried by first responders has played an important role in survival. Each minute that the heart remains in fibrillation results in a decrease in survival of approximately 10% (Hagan, 2009). However, the research has shown that a decrease in response is only effective in certain medical emergencies. Cardiac arrest, myocardial infarction, stroke, airway obstruction and severe trauma, the majority of calls to which EMS is dispatched aren't as time-sensitive and don't show better outcomes with a more rapid response ("Should Response Time Be a Performance Indicator?" 2015).

The data from FCEMS indicated that the information given to a dispatcher and the

information the paramedic documents upon contact is the same 62% of the time and only 13.59% being related to cardiac, the need for community impute will be necessary to determine which calls WSFD should respond to. More specific items for measuring how well the WSFD meets the community needs. Item examples could include public perceptions of “expected wait time forms to arrive after a 9-1-1 call” or types of calls they expect an emergency response to (Blau, Portwood, & Hochner, 2012).

It is important to make sure that the WSFD is being dispatched on medical calls that require a quick response. Sending the wrong response to a medical call can result in firefighter injuries and creates safety issues for the community. Unnecessarily high operating costs are the most visible result of clinging to an expensive, "just-in-case" delivery model for this core public service (Keisling, 2015). There can be a reduction in operating cost and wear and tear on fire apparatus, when the right resources are sent to an emergency.

WSFD firefighters are trained to an Emergency Medical Technical certification, but paramedics cost more. Firefighters can provide life-saving intervention (such as chest compressions), remove the victim from a hazardous environment, dress wounds, and other basic life support until the paramedics arrive to perform advanced care and transport. This is a benefit to the community and a cost effective measure to the ambulance service, but not to the fire department.

In 2016, the WSFD responded to 26,564 total number of calls (City of Winston-Salem, 2017). Of that total, 836 of those were actual fire calls, 17,631 were medical responses, and 8,097 were other types, such as false alarms, service calls, and hazardous conditions (City of Winston-Salem, 2017). Of the 17,631 medical calls and WSFD reported helping the medics on 66% of the responses. The data review showed that WSFD sent apparatus on way too many

service calls, the resource was not properly matched to the need, 34% of the time.

Home Territory One, Four, and Three are located in the downtown area of Winston-Salem and represent to highest demand for medical responses. Therefore, in order to see a reduction sufficient enough on high- acuity calls a QRV would be necessary at Station One and Station Four. A QRV will increase the reliability in those home territories and help reduce wear and tear cost of an apparatus. However, adding personnel to staff the QRV make the program more expensive than sending an apparatus on the medical call.

Recommendations

The mission of the City of Winston-Salem Fire Department has always been to provide the very best and efficient services to the citizens they serve at the lowest cost possible. The following recommendations aim to support this continued effort to achieve better efficiency. It should be the goal of any emergency service' organization to seek out new avenues of service to provide to the citizens within the community. Just as much, it should be the goal of that same organization to search for better ways to fund these initiatives.

While researching the feasibility and effectiveness of a QRV in the City of Winston-Salem, several issues were identified which will need to be addressed, some at no cost, before introducing a QRV concept. Based on the extent of the research, the information obtained, and its review, the following recommendations are made.

Create unified dispatch procedures and response models for medical calls. Response codes should be created and categorize to meet the need for the reported medical emergencies. For example, a stubbed toe would receive no response of a fire apparatus and a cardiac arrest call would require a response of a fire truck with lights and sirens. Currently, this is established by FCEMS and the WSFD has limited input on the recommendations.

Complete a detailed analysis of current fire apparatus responses to determine which calls require the response of a QRV or a fire apparatus. Specific questions should be asked in order to assign the right resources to the emergency. For decades our citizens were told to call 9-1-1 when they have a problem. Now our 9-1-1 systems are overrun with non-emergent calls, and we keep responding the same resources. Matching supply and demand, improving component times, responding appropriately, harnessing technology and ensuring transparency are all essential to improving response time performance. This is a fire department decision and should play a vital role in establishing the best responses within the PSAP center. As the research has shown 66% of people calling 9-1-1 for emergency responses know what is wrong with them. There is no such thing as an inappropriate request for 9-1-1. There is such a thing as an inappropriate response to that request.

The WSFD must have more ownership within the communications center and have the ability to make changes to unit recommendations as necessary. The department should also be actively involved with training telecommunicators. This is necessary because the telecommunicator plays an important role in sending the right resources to an emergency. Currently, the PSAP manager reports to the Police Chief within the City of Winston-Salem, one recommendation is to have the PSAP manager report to both the Police Chief and the Fire Chief. An intergovernmental agreement should be created for the City of Winston-Salem PSAP center and a mutual agreement of understanding with FCEMS. This will create transparency between all organizations.

All medical calls dispatched should be dispatched from the same PSAP. This would allow for consistent dispatch of resources, more consistent data, better response times, and increase communications between the ambulance and the fire unit.

The WSFD should create a team to work with the community to identify their expectations and to create a community driven strategic plan. Expectations should include but not be limited to response times, what they expect when they call 9-1-1, how they expect to be treated, and what cost they are willing to pay. The expectations of the community are the foundation of any program the WSFD would like to implement.

The WSFD should consider creating strategic and performance division, led by an Assistant Chief. This division should focus on Accreditation, community risk reduction, data analytics, response plans for medical emergencies, conduct root cause analysis of firefighter injuries, and the overall safety of our community. They should create more outreach programs to the public with their findings. This could increase public support for EMS initiatives, fire initiatives, and better response models, potentially saving more money in the future. The WSFD should continue to focus on Accreditation through the Center for Public Safety Excellence, a Standard of Cover will be completed, and this mandates a deep look at risks and what type of response each one will receive.

Continue to utilize fire apparatus to respond to medical emergencies, depending on the community expectations. Although, there are many benefits to having a QRV and the maintenance cost are much less. The WSFD will not be able to manage a QRV program if personnel are not added, which makes the program more expensive. The WSFD should address the identified issues before making a decision regarding a QRV response and continue to analyze the data.

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Appendix A

Survey Results

Name of Fire Department and State 16 responses

City of Lenexa Kansas FD
Fayetteville Fire/Emergency Management
Morrisville Fire/Rescue Dept, NC
City of Asheville FD
Wake Forest Fire, nc
Fayetteville Fire/Emergency Management, NC
Matthews Fire & EMS
Jacksonville Fire and Emergency Services NC
HIALEAH FIRE DEPT
Valdosta Fire Department, Georgia
Hinesville Fire Department Georgia
City of Hahira Fire Department - Hahira, GA
Golder Ranch Fire District
Houston Fire Department, Texas
Spokane Fire Department
Ames Fire (Iowa)

Number of medical calls annually? 16 responses

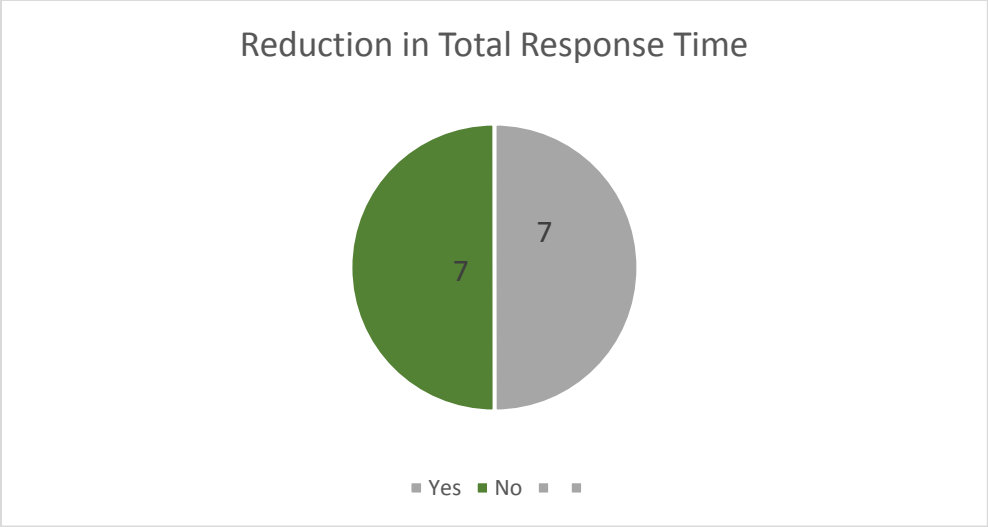
5600
18000
750
9000
2100
20000
1600
2400
30000
2000
2500
480
12000
292000
50000
2650

Total population served? 16 responses

520000
186000
Approx 28,000
96,000
45k
208,000
31,000
70145
235,000
56,538
35000
3650
120000
2,500,000
230000
65,000

What is the staffing model? 16 responses

2 on each squad
2
2 Quints, 1 Pumper (1000 gal Engine), 1 Heavy Rescue, 1 Squad
Company would all go in the QRV
2 firefighter
2 firefighters on squad
2 EMTs on a Squad, 3 FFs on Eng or Ladder
Squads are staffed 2 personnel and are the first units dropped to maintain staffing requirements
3 FF paramedic crew rescue unit. 3 FF paramedic als enginec
We are not currently able to staff the vehicle as it should with at least two.
We have 4 person engine companies
Full Time Firefighter/EMT
2 person bls sometimes als
2 EMT Basic on 78 BLS units, 2 Paramedics on 30 ALS units, and 2 Paramedics on 15 QRVs
2 ff EMT or PM depending on daily staffing
5 person engine and truck companies, if a medical call comes in will the engine or truck is still there, then 2 will take the rescue unit to the medical incident, leaving as many as 3 or as little as 2 on the engine or truck



If "yes “please provide information on the total response reduction?

7 responses

15 to 60 seconds faster with QRV

Rescue units supplement also engine response and facilitate patient transport to the ED

We saw a 25 second reduction in response.

Reduction in response times from average 9 min to 3 min average.

Yes but we are still quantifying

Complicated. Measure UHU.

10 seconds

What is the staffing model of the QRV?15 responses

2 (2)

Two paramedics perfected but can run with one paramedic and one emt.

Minimum staffing is an Engineer qualified to as fill in officer and one firefighter off probation.

Company would all go in the QRV

2 firefighter

2 Firefighters

2 EMTs or FF/EMTs

2 personnel

It is only staffed when we are above minimum staffing levels

2 person

Our primary Engine is equipped as a BLS Engine that responds to all medical calls within the city, to reduces response times, provide quicker patient care and have the ability to free up additional ambulances quicker.

2 Paramedics

24hr units and peak units.

2 FFs

Please provide any information on cost savings of a QRV? 12 responses

$50,000 ish

In theory the savings is the wear and tear on the Quint running out if the same station.

In our 20 years' experience we were not saving but instead we were losing around $6,000 per QRV per year

None

Wear and tear on larger apparatus and availability of suppression apparatus. Actual cost savings not determined.

There really isn't a true cost savings due to the maintenance. Only real savings might be the increased life span of the engines

A fully staffed QRV would greatly reduce operating cost opposed to running engines out on medical calls. I hope to justify a future increase in staffing by showing the reduction in operating costs.

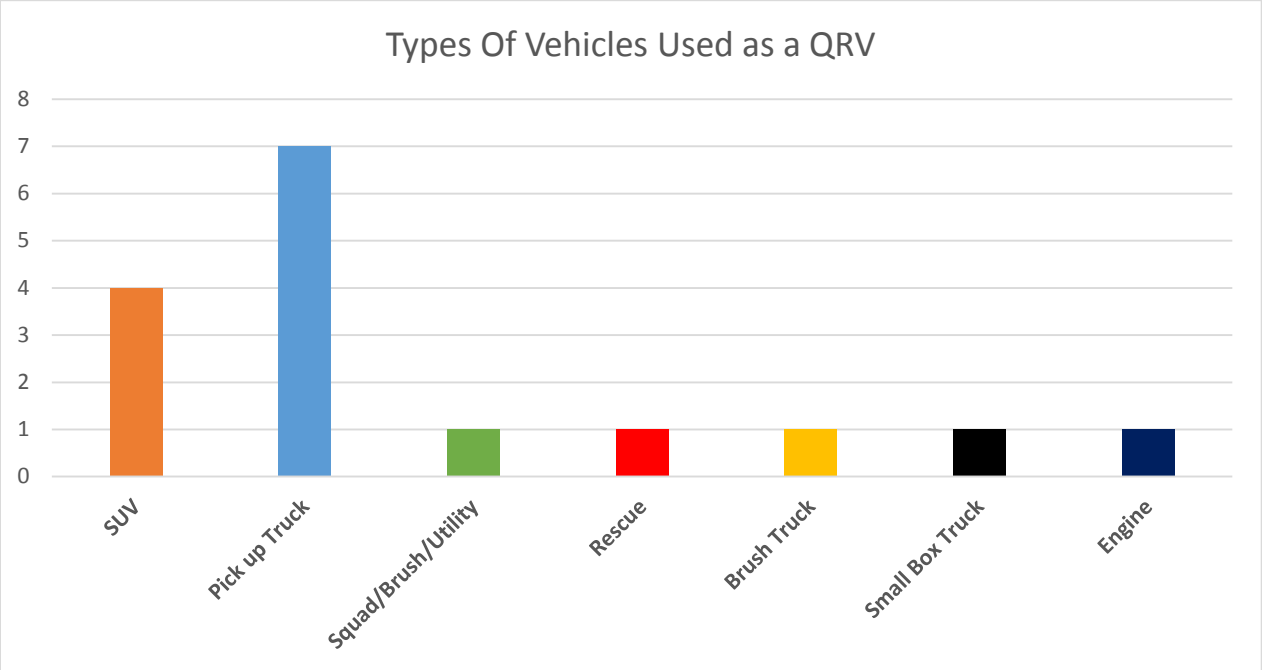
Email if you want details. Too much to fit on line.

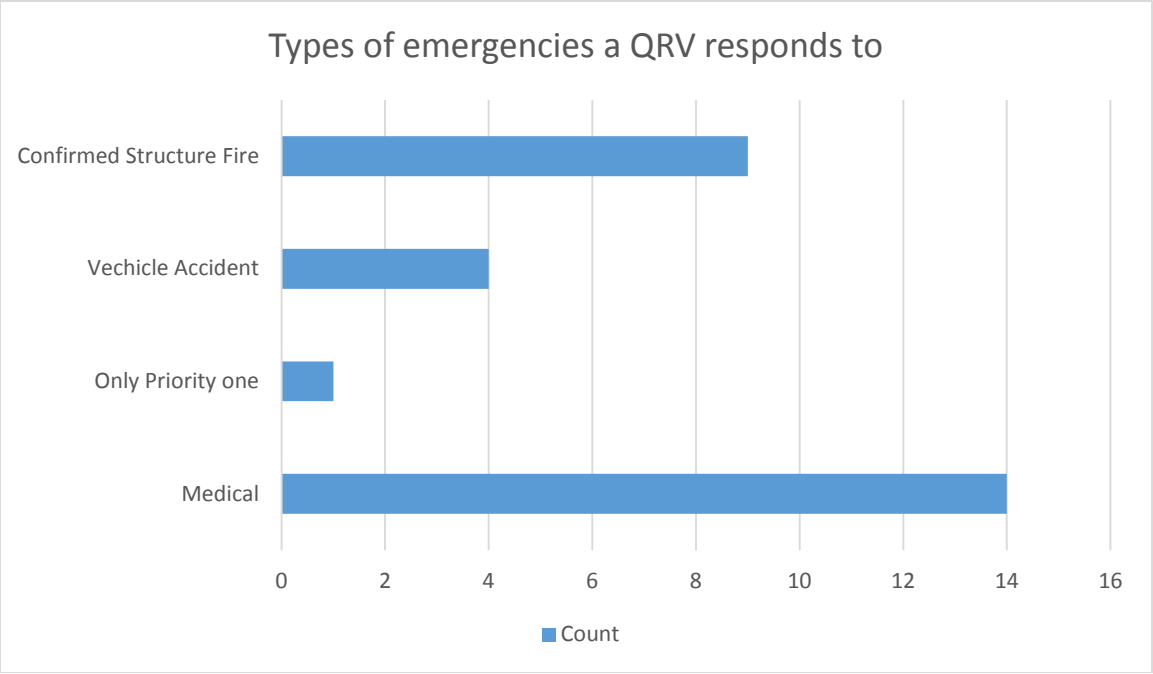
None yet because of startup costs

An SUV is cheaper than a transport unit; however, it is suspected the QRV has increased the frequent fliers due to non-transporting.

Fuel/maintenance, additional unit hours, surge capability, improved ERF

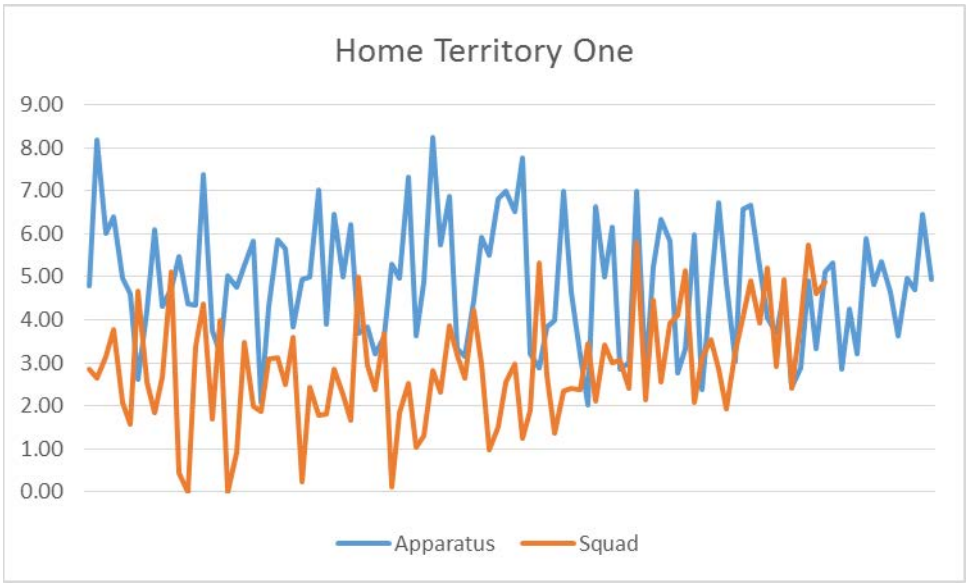
40% cost savings just in maintenance costs. We can also purchase QRVs at 16% of the costs of our current rescue units ($155,500 vs. $24,800)

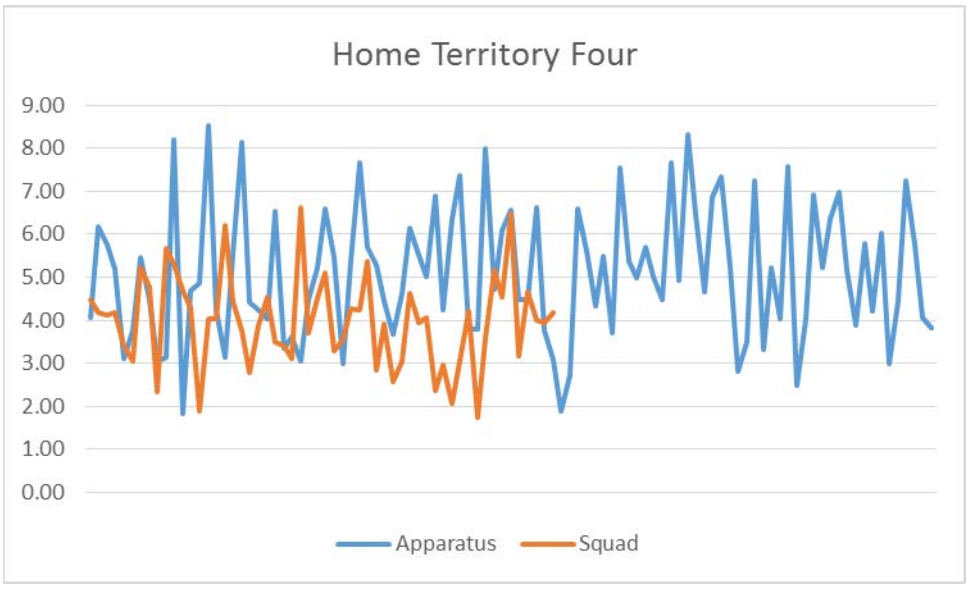


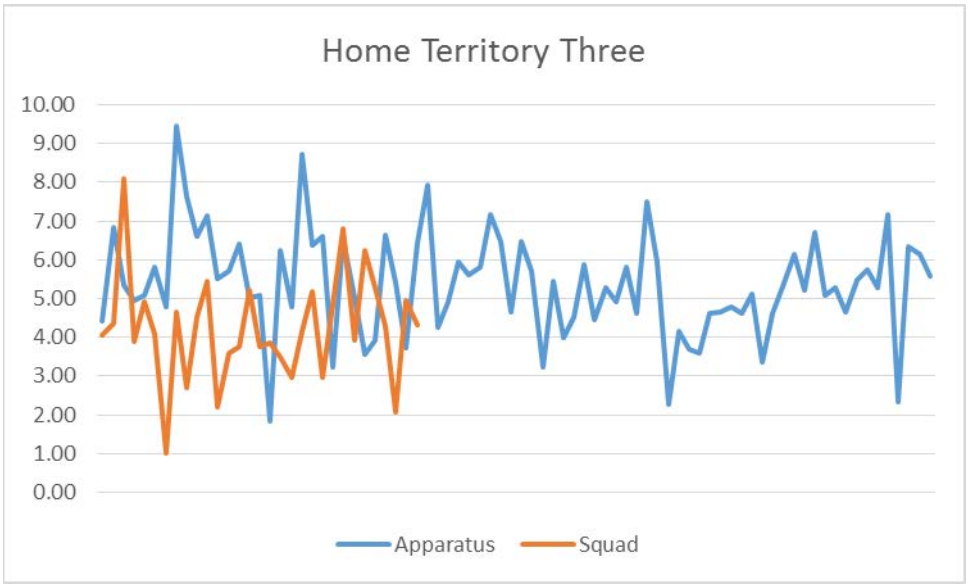

Types of emergencies a QRV responds to
Confirmed Structure Fire
Vechicle Accident
Only Priority one
Medical
0
2
4
6
8
10
12
14
16
Count

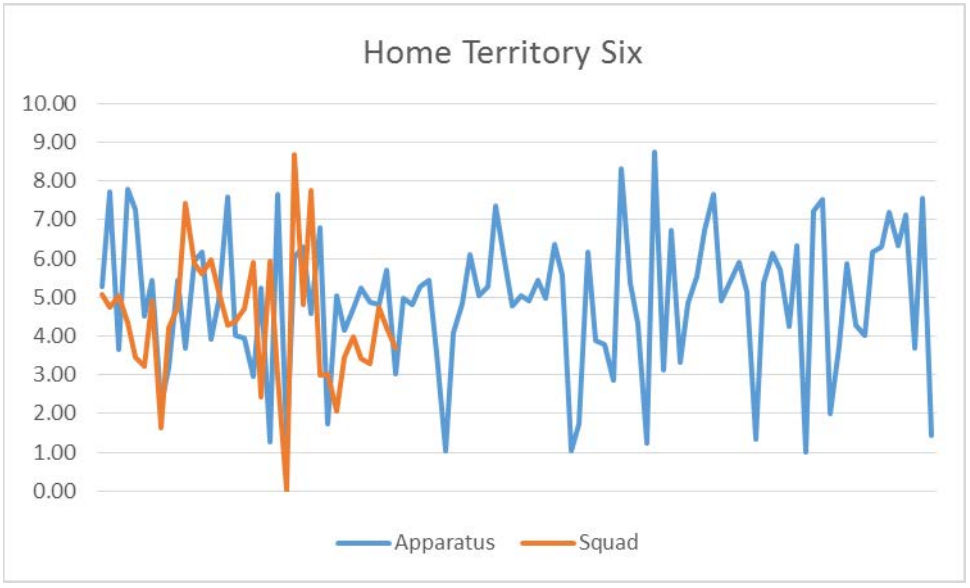
Appendix B

Comparison of Total Response Time between a Squad and Fire Apparatus






Home Territory Three
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Apparatus
Squad


Home Territory Six
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Apparatus
Squad

Appendix C

Medical Response Data

Patient Reported and the First Medic's Impression

EMS found	Count of Calls EMS arrived to find what the patient said
Abdominal	780
Active Lab	11
Airway Obstruction	10
Allergic Reaction	112
Altered Level of Concisions	506
Anaphylaxis	5
Asthma	75
Behavioral	817
Bleeding	3
Bowel Obstruction	2
Cancer	1
Cardiac Arrest	123
Cardiac Rhythm	178
Chest Pain	964
CHF (Congestive Heart Failure)	18
Coma	1
Dehydration	20
Diabetic	279
Dialysis	8
Electrocuted	1
Emphysema	5
Epistaxis	11
Exhaustion	11
Febrile Seizure	21
Fever/Infection	216
G.I. Bleed	24
Generalize	1116
GI Bleed with pain	4
GI/GU	106
Headache	210
Hemorrhage	148

Hepatic	2
Hypertension	59
Hyperthermia	5
Hyperventilation	6
Inhalation	4
Malaise	7
MI-STEMI	8
Nausea	17
Neuromuscular	19
No Complaint	558
Obvious Death	44
Other	39
Other Abdominal	5
Other Cardiac	16
Other Neurological	40
Other OB/G	27
Other Respiratory	157
Pain (Non- traumatic)	456
Poisoning	294
Post-operation	4
Pregnancy	39
Renal Failure	3
Respirator	1071
Resuscitation	2
Seizure	396
Sexual Assault	7
Smoke Inhalation	2
Stings	8
Stroke	225
Substance Abuse	175
Suspected	17
Syncope/ Fainting	360
TIA	6
Traumatic	1649
Undefined	88
Vaginal Hemorrhage	12
62% of the time the patients complaint to the telecommunicator matched the medics first impression	

FY 2016-2017

Emergency Medical Call impacted by Total Response Time

Type of Emergency	Total as a number	Total as a percentage
Cardiac	390	29.73
STEMI	7	0.06
Death	42	0.36
Respiratory Distress	1063	9.16
Respiratory Arrest	9	0.07
Stroke	66	0.57
13.59 % of calls where first responders have a direct impact on outcomes		

Appendix D

Apparatus Information

Maintenance				**Maintenance**			
Annual/First year of purchase	**Command Van**		**Total**	**Annual/First year of purchase**	**Apparatus**		**Total**
Oil Change	$37.65	x5	$188.25	Oil Change	$286.90	x4	$1,147.60
Wipers	$17.44		$17.44	Wipers	$8.00	x3	$24.00
Inspection	$30.00		$30.00	Inspection	$30.00		$30.00
Fuel			$1,582.70	Ladder Test	$475.00		$475.00
			$1,818.39	Pump Maintenance	$26.20		$26.20
				Fuel			$6,524.42
Year Two							**$8,227.22**
Annual			$1,818.39	Year Two			
Brakes	$326.26	Labor $195	$326.26	Annual			$8,227.22
Battery	$102.04	Labor $75	$102.04	Tires	$3,170.00	all six	$3,170.00
Tires	$150.00	x4	$600.00	Tires Mounted	$0.00		$0.00
Tires Mounted	$28.00		$28.00	Brakes	$1,577.77		$1,577.77
			$2,874.69				**$12,974.99**
Year Three				**Year Three**			
Annual			$1818.69	Annual			$8,227.22
trans flush			$250.00	Battery	$570.00		$570.00
			$2,068.69	Air Filter	$23.00		$23.00
Year Four				Pump Packing	$325.00		$325.00
Annual			$1,818.69				**$9,145.22**
Brakes	$326.26	Labor $195	$326.26	**Year Four**			
Battery	$102.04	Labor $75	$102.04	Annual			$8,227.22
			$2,246.99	Tires	$3,170.00	all six	$3,170.00
Year Five				Tires Mounted	$0.00		$0.00
Annual			$1,818.69	Brakes	$1,577.77		$1,577.77
Tires	$150.00	x4	$600.00	Transmission	$311.59		$311.59
Tires Mounted	$28.00		$28.00				**$13,286.58**
			$2,446.69	**Year Five**			
				Annual			$8,227.22
				Air Filter	$23.00		$23.00
				Pump Packing	$325.00		$325.00
				Battery			$380.00
							$8,955.22

Tahoe and Equipment

Purchase of a Tahoe		
Radio Equipment:		
Mobile Radio (1)		$4,610.56
Portable Radios with Chargers(2)		$14,943.50
Lights and Sirens		$7,384.32
TOTAL:		**$26,938.38**
Wrap and Equipment:		
Van Wrap and Markings		$2,000.00
Slide In Equipment Holder		$4,500.00
TOTAL:		**$6,500.00**
Medical Equipment		
Medical Bag & Equipment		$4,500.00
AED (1)		$2,515.00
Backboard (1)		$295.00
Traction Splint (1)		$129.75
KED		$98.00
TOTAL:		**$7,537.75**
Total Equipment Cost:		**$40,976.13**

Fuel Cost

Tahoe				**Engine Four**		
Miles (average)	8,014	12 miles to the gallon		Miles (average)	8014	3.39 miles to a gallon
Fuel (average)	668			Fuel (average)	2,364	
Fuel Cost (average)	$1,582.70			Fuel Cost (average)	$6,524.82	

Total Annual Cost Including Fuel

	Year One	**Year Two**	**Year Three**	**Year Four**	**Year Five**
QRV (Tahoe) Maintenance	$42,794.52	$2,874.69	$2,068.69	$2,246.99	$2,446.69
*Personnel (Firefighter)	$49,532.00	$50,522.64	$51,533.09	$52,563.75	$53,615.02
*Personnel (Engineer)	$64,468.76	$65,758.14	$67,073.30	$68,414.77	$69,783.06
**QRV Total	**$156,795.28**	**$119,155.47**	**$120,675.08**	**$123,225.51**	**$125,844.77**
**Fire Apparatus	**$8,227.22**	**$12,974.99**	**$9,145.22**	**$13,286.58**	**$8,955.22**
Difference	$148,568.06	$106,180.48	$111,529.86	$109,938.93	$116,889.55

Note: Year one includes a purchase of one Tahoe
**Including 2% annual increase on pay only*
***Not including any type of repairs or inflation*