Executive Leadership

Dispatcher Prioritization of 9-1-1 Medical Calls in the City of San Bernardino CA: The Impact on Patient Care.

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Abstract

The system used by San Bernardino City CA. Fire Department (SBFD) dispatchers to prioritize 9-1-1 medical calls for service had not been formally evaluated to determine its impact on patient care and overall service delivery. The purpose of this research was to analyze specific elements of SBFD’s response prioritization system to determine its ability to effectively allocate resources based on patient needs, and to examine its potential effect on patient care. Evaluative methods were used to analyze dispatching records and patient care data from emergency medical service (EMS) calls processed through SBFD’s 9-1-1 communications center. The research answered the questions of how much impact the use of this system had on EMS resource availability and response times, how proficient SBFD dispatchers are in following system protocols, and how often the system’s use results in insufficient resources being sent to a medical call for service. The research found that the system’s use increased EMS resource availability by 10.2% on average, and decreased response times to specific higher priority medical calls by up to 32.5%. The research also found that SBFD dispatchers were proficient in following established system protocol, with average protocol compliance scores of greater than 95%. Finally, research found that in 6.5% of the EMS calls categorized by dispatchers as lower priority, the patient could have benefited by a higher priority response. However, the research concluded that the system’s use resulted in a greater number of patients being affected by the positive benefits of a shorter response times than were affected by a lower priority response. Recommendations were made on where changes in the system could be made to improve its efficiency, and how it could be expanded to improve EMS delivery in the City of San Bernardino.
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Dispatcher Prioritization of 9-1-1 Medical Calls in the City of San Bernardino CA: The Impact on Patient Care.

Introduction

Over the past decade, the number of emergency medical service (EMS) calls that the San Bernardino City Fire CA. Department (SBFD) has responded to has increased at an average rate of 7% per year. This increased demand on fire department resources has resulted in a decrease in service level due to response times that are longer than the standards established by the SBFD. In response to this trend, the SBFD implemented an Emergency Medical Dispatching (EMD) program in their emergency communications center that included a system of prioritizing EMS calls for service.

This call prioritization system uses SBFD dispatchers to allocate resources to each medical call for service based on the medical urgency of the patient’s chief complaint and their reported symptoms. The chief complaint and symptoms are determined through the caller’s responses to a series of medically based questions asked by trained SBFD dispatchers.

There is evidence that the system’s use increases SBFD’s advanced life support (ALS) resource availability and decreases their response times. Each of these outcomes helps ensure that these resources can respond in a timely fashion when they are critically needed. However, there is also evidence that occasionally, the system recommends sending basic life support (BLS) resources to calls for service when it is later determined that the patient’s condition warranted ALS intervention. This usually occurs because of incomplete or errant information provided by the caller, sudden changes in the patient’s condition, or dispatcher error.
The evidence from each of these scenarios represents potential clinical benefits and risks to the patient. The problem, however, is that insufficient research has been done to determine the frequency in which each scenario occurs, or the potential impact that each scenario could have on patient care. The purpose of this research was to measure the systems impact on emergency medical service (EMS) resource availability and response times, its ability to effectively allocate resources based on the patient’s medical condition, and to determine dispatcher proficiency in following the system’s protocols.

Evaluative methods will be used in conducting this research. By collecting and analyzing SBFD’s computer aided dispatch (CAD) records, the research will first answer the question of how much impact the dispatch prioritization system used by SBFD has on ALS resource availability in the SBFD. Using the same records, the research will answer the second question of how much impact the dispatch prioritization system used by SBFD has on ALS response times for 9-1-1 callers with higher priority medical symptoms in the City of San Bernardino.

The third question that this research will answer is how often the system’s use results in BLS resources responding to medical calls where it is later determined that ALS intervention was indicated either by protocol or by clinical presentation. This question will be answered through a review of medical records from patients who received a BLS response due to the use of SBFD’s call prioritization system. Finally, the research will answer the question of how proficient SBFD dispatchers are in following the EMS call prioritization protocols used to determine the appropriate level of response for each patient. Based on the findings of this research, recommendations will be made
on how the SBFD could effectively use its emergency dispatching resources to increase their effectiveness in pre-hospital EMS delivery.

Background and Significance

As the public’s expectation of fire and emergency service agencies continues to expand, fire department leaders are faced with the challenge of meeting increasing service demands with limited resources. One notable example of this type of service expansion is the delivery of pre-hospital EMS by fire service agencies. Once considered a secondary duty in many fire service organizations, EMS delivery has now come to the forefront of operations in most fire departments across the United States. Recent statistics indicate that nationally, over 55% of all fire department calls for service are EMS related, while actual fire runs have fallen to about 8% (United States Fire, 2007).

The evolution of emergency services provided by the SBFD is similar, if not more pronounced than the national trends. Established in 1878, the SBFD has a long and proud heritage of service to the community. Like most fire departments, the SBFD’s roots trace back to its original exclusive mission of suppressing fires. Over time, however, the citizen’s of San Bernardino City voiced a clear desire to expand the department’s role to include the delivery of pre-hospital medical care.

In response, the SBFD instituted the City’s first fire department based paramedic program in 1976. The program began with 23 paramedics responding from 3 of the City’s 10 fire stations. All other emergency operations personnel were trained to a minimum level of Emergency Medical Technician-1 (EMT-1) (Shaw, 2003). At that time, the city’s population was approximately 80,000 people, and although the public favored the paramedic program, no additional funding was secured to sustain it.
Currently, the SBFD employs 159 emergency operations personnel delivering fire protection and EMS to nearly 200,000 citizens. Since the fire based paramedic program was initiated in 1976, the department has opened two additional fire stations, placed paramedics on every SBFD engine company, added a two-person paramedic squad, and nearly doubled the number of paramedic trained fire personnel employed by the fire department. Although the SBFD is the primary ALS provider in the City of San Bernardino, they do not provide medical transportation. This service is provided through a contract with a private medical transportation company.

The majority of this expansion in the SBFD has been accomplished through the City’s general fund monies. No dedicated tax revenue source has been established to sustain the EMS program. This frequently places Fire Department needs in competition with other vital City needs, with funding that is often insufficient for meeting all of the City’s desired goals.

Even so, the need to provide for this growth in the SBFD has been supported by two primary factors. First, as the population increased and the demographics shifted in the City, the number of fire and EMS related calls for service began to increase substantially. Between 1998 and 2006, the department experienced an increase in EMS call volume of 75% (see Figure 1), with an average annual increase of nearly 7%. During calendar year 2006, the department received 3,253 fire calls for service and 24,731 EMS calls for service (Karschner, 2006).

The second factor, which added a new dynamic to the increasing call volume, was the adoption of a resolution in 2000 by the City’s mayor and common council that implemented performance benchmarks for the fire department. This included a response
time standard of 7 minutes or less on 90% of all fire department emergency calls for service. This 7-minute standard is measured from the time a call for service is received at SBFD’s emergency communication center to when an SBFD resource arrives at the scene of the emergency.

Although this is a reasonable and appropriate goal, the pattern of increasing call volume was hindering the SBFD’s ability to reach the goal on a consistent basis. Resources that should have been responding from fire stations located closest to a call for service were often already committed to other calls. This resulted in resources responding from fire stations or other locations that were further from the call. The effect of this pattern was response times that were longer than the established standard. In addition, this increase in call volume resulted in decreased resource availability for other non-EMS emergencies such as fires, technical rescues, and hazardous materials incidents.

Even with SBFD’s attempt to deal with this trend through the addition of fire stations and EMS resources, the call volume continued to outpace the department’s ability to meet established response time standards. From a clinical perspective, these increased response times had the potential to cause a delay in critical medical intervention, which could lead to negative patient outcomes. Ultimately, the call load pattern was creating an overall decrease in service level to the citizens of San Bernardino.

Recognizing this, SBFD leaders began working on ways to deal with the trend by focusing on two primary options. The first option would be to add EMS resources to the system to meet the call demand. Although this option would be effective, it would also represent a substantial cost to the citizens of San Bernardino, as it would require hiring additional full-time employees and purchasing additional equipment.
The second option was to take steps to manage the existing resources to ensure maximum effectiveness in the fire department’s deployment pattern. Research into this option found that other cities with similar challenges had showed success in managing their call volume by implementing an EMS call prioritization system. The SBFD leadership felt that such a system would allow minor medical calls to be handled by BLS and ALS resources from the contracted ambulance company, thereby ensuring that ALS resources from SBFD would be reserved for the most serious medical calls. This option had a great deal of appeal because it included making the most of the existing resources, and did not call for a significant amount of additional taxpayer dollars.

Figure 1: SBFD Fire and EMS Calls For Service From 1998 through 2006
In 2001, the SBFD took its first steps in implementing an EMS call prioritization system. The City chose a commercially available system called Medical Priority Dispatch System (MPDS). This system, which is still currently in use by the SBFD, provides a mechanism by which dispatchers can send the most appropriate EMS resource to a call for service based on the medical acuity of a caller’s chief complaint. Calls categorized as low acuity generally receive a BLS response by the department’s contracted medical transportation company, and do not require a response by SBFD resources. Higher acuity calls receive an ALS response with both SBFD and the contract medical transportation company (see Table 1). By using this system, the SBFD has been able to reduce the number of ALS responses, with the goal being to increase ALS resource availability for the most serious and time sensitive medical emergencies.

The system, however, has not been without controversy. Skeptics of the system suggest that because it has the potential to incorrectly triage calls for service, its use could lead to sending resources that are not adequate for the patient’s immediate needs. This could have a negative effect on the patient’s outcome, and increase liability for the community. As a result, the system has been publicly scrutinized by other local fire department leaders, with statements suggesting that the system may do more harm than good (Brooks, 2001). Statements from the director of one neighboring county’s emergency medical service agency suggested that such triaging of calls would move the EMS delivery system backwards, and that it was unlikely that their county would approve any system that does not put an ALS unit on every call (Trone, 2007).
Table 1

Overview of Response Criteria Used by SBFD based on MPDS Protocols.

<table>
<thead>
<tr>
<th>Response level type</th>
<th>Acuity level</th>
<th>Level of response</th>
<th>Response time standard&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>Very low</td>
<td>BLS Ambulance</td>
<td>19 min. 59 sec. or less on 90% of responses</td>
</tr>
<tr>
<td>Bravo</td>
<td>Low to moderate</td>
<td>ALS Ambulance</td>
<td>11 min., 59 sec. or less on 90% of responses</td>
</tr>
<tr>
<td>Charlie</td>
<td>Moderate to High</td>
<td>SBFD ALS unit and ALS ambulance</td>
<td>7 min., 59 seconds or less on 90% of responses</td>
</tr>
<tr>
<td>Delta</td>
<td>High</td>
<td>SBFD ALS unit and ALS ambulance</td>
<td>7 min., 59 seconds or less on 90% of responses</td>
</tr>
<tr>
<td>Echo</td>
<td>Very High</td>
<td>SBFD ALS unit and ALS ambulance</td>
<td>7 min., 59 seconds or less on 90% of responses</td>
</tr>
</tbody>
</table>

<sup>a</sup> The measurement of this response time standard begins when the 9-1-1 call for service is received at the responding agencies respective dispatch center and ends when the assigned unit arrives at the scene of the emergency.

Clearly, under-triaging a call that results in sending inadequate resources to a time-sensitive medical emergency could have a negative impact on the patient’s outcome. Observations of the effectiveness of SBFD’s call prioritization system made through regular quality assurance reviews indicate that the system has sent BLS resources on calls where it was later determined that ALS intervention was indicated. However, the
occurrences of this are infrequent, and there are no documented cases where a patient’s outcome was affected by the lower level response. Even so, it represents patients who may not have received the level of care that the SBFD is committed to providing. Therefore, each incident is viewed as significant.

However, periodic reviews of SBFD’s dispatch records indicate that if the call prioritization system were not in place, the closest ALS resources would not be available for medically urgent calls at a more frequent rate. This is because calls for service would go back to being assigned on a first-come, first served basis rather than by the potential medical severity of the call. The potential effect of sending these limited ALS resources on every EMS call, regardless of severity, is longer response times to potentially time sensitive medical emergencies. Therefore, this scenario could create negative patient outcomes similar to sending an inadequate response.

The frequency at which each of these scenarios occurs in San Bernardino City, and the degree to which each circumstance would affect patient care has not been studied prior to this applied research project. Therefore, the findings of this research could have a significant impact on the SBFD’s approach to resource deployment, as it will identify the potential impact of maintaining, modifying, or discontinuing the use of this call prioritization system. The decision on which option to pursue will have a direct impact on patient care, and the amount of tax dollars that will need to be allocated to the fire department in order to reach service goals.

The research findings may have a broader impact as well. The call prioritization system used by the SBFD is widely used across the country and internationally. Therefore, any identified deficiencies or advantages in SBFD’s system would likely be
present in other communities with similar characteristics to San Bernardino City. In addition, the research results may persuade communities who are considering a call prioritization program to either pursue the concept further, or reject the option entirely. In each case, the efficiency and effectiveness of EMS delivery will be affected.

Ensuring that innovative approaches such as EMS call prioritization meet the needs and desires of the community exemplifies the mission of the SBFD. Additionally, this research and the motivation behind it reflect the desired outcome of the National Fire Academy’s Executive Leadership course from several perspectives. First, one of the skill/action areas identified as a key element of executive fire officer leadership is the ability to perform analysis and exercise judgment (Department of Homeland Security, 2005). This research exemplifies the application of these skills, as it requires not only the retrieval and analysis of data, but also the ability to apply the findings in the best interest of the community.

Another connection to the Executive Leadership course involves developing and implementing effective decision-making skills, particularly when the decision process must include input from other stakeholders and policy makers. In this case, any changes to a pre-hospital response system must first be approved by the San Bernardino County Medical Director. In addition, it is important that other stakeholders such as SBFD’s contract ambulance company, local hospitals, care facilities, and mutual aid cooperators are willing to participate in any modifications in service delivery that may be identified through this research.

Clearly, the SBFD is not in a position to run a program like this unilaterally. Therefore, skills of persuasion, influencing, and negotiating will need to be employed
throughout this process in order to achieve a positive outcome for the community. These skills are also focus areas identified in the Executive Leadership course.

The nature of this research also promotes the mission of the United States Fire Administration (USFA) by addressing three of their established operational objectives. These include a 25% reduction in civilian life loss for those over age 65, a 25% reduction in life loss for those under age 14, and a 25% reduction in firefighter life loss. (United States Fire, 2001). Recommendations based on the findings of this research will directly affect the quality and efficiency of pre-hospital emergency medical care in San Bernardino City, and possibly other communities as well. As such, the research will contribute to the USFA’s operational objectives of reducing civilian life loss in both target age categories.

The third operational objective that the research connects to involves the reduction of firefighter fatalities. According to national statistics, responding to the scene of an emergency is the second most common type of duty associated with firefighter fatalities (TriData Corporation, 2002). Effective use of response prioritization systems has the potential to decrease the number of units responding to a single incident, and decrease the overall number of lights and siren responses. Each of these reduces the frequency at which firefighters are exposed to this high-risk operation.

Literature Review

The literature review for this applied research project focused on the evolution of emergency call prioritization, the development of the Medical Priority Dispatch System (MPDS), which is used by SBFD, and the general civilian usage patterns of ALS resources in pre-hospital care. The literature review also focused on the sensitivity and
reliability of call prioritization systems, the impact that using a call prioritization system has on response times, and the impact of response times on patient outcome. Impact was evaluated by reviewing the system’s effect on resource availability, level of care provided, response times, and the potential clinical implications of each of these points.

*Evolution of emergency call prioritization and pre-arrival instructions.*

The concept of enhancing the structure of EMS dispatching procedures to include medically based call-taker intervention began sporadically throughout the early 1970s (Zachariah, 1995). The concept began to take formal shape by 1976, when the United States Department of Transportation drafted the first EMD curriculum guidelines (Larson, 1998). The concept was further refined through research and dispatching protocol development of Dr. Jeffrey Clawson in Salt Lake City, Utah (Maggiore, 1997). By the early 1980s, several EMS providers were delivering some form of medical pre-arrival instructions through their communication center, including Aurora, Colorado, King County, Washington, and Salt Lake City, Utah (Zachariah, 1995).

Initial attempts at using call takers in emergency communication centers to provide medical guidance or triage were not without troubles. In an attempt to increase the level of medical knowledge in their dispatching center, the city of Dallas Texas hired nurses to work in the center to provide pre-arrival instructions to callers with medical emergencies (Adams, 1984). In January of 1984, one of the nurse-dispatchers underestimated the severity of an elderly female with a reported altered level of consciousness, resulting in a delayed response. The patient ultimately died of what was diagnosed as a heart attack, and the patient’s family pursued legal action. The city of Dallas eventually settled out of court with the family for 2.2 million dollars (Lazar,
Following the lawsuit, incomplete and misleading information from the press on the concepts of appropriate emergency medical dispatching resulted in an outcry from some community members to discontinue any further use of such programs (Stout, 1984).

Another similar incident occurred on 1987 in Los Angeles California when a dispatcher apparently misdiagnosed a breathing problem as hyperventilation. The dispatcher advised the patient to breathe into a paper bag, and call back if anything changed (Clawson & Dernocoeur, 2000). After a total of three calls through 9-1-1 for assistance, the family tried to move the patient to a car to transport her to the hospital. At that point, the patient went into cardiac arrest, and did not survive (Spiegel, 1988).

In response to this incident, the City of Los Angeles made a policy decision that included sending ALS resources on every call regardless of the apparent severity. This resulted in daily responses by ALS resources to minor medical calls such as sore throats and cut fingers (Becklund, 1991).

Incidents such as these caused a great deal of controversy over the effectiveness and appropriateness of using the 9-1-1 system to triage calls for service or offer medical guidance over the phone. At the same time, there was a growing expectation from the public that dispatchers should be able to provide some kind of appropriate intervention in critical situations before EMS resources arrive on scene. Examples of dispatchers refusing to give any pre-arrival instructions include a 14-month old drowning victim in Florida (Clawson, 1991), and a 1-year-old drowning victim in California (Clawson & Dernocoeur, 2000). Each of these led to negative public scrutiny of the respective dispatch centers, and further debate on whether providing emergency medical dispatching was irresponsible, or a moral duty.
In analyzing such arguments from a liability perspective, Maggiore (1997) concluded that including dispatchers as part of the EMS system and providing EMD must become a critical piece of the patient care response system in order to ensure prompt and efficient care. Research by Thakore, McGugan, & Morrison (2002) further supported this argument by noting that using dispatchers to establish the urgency of a medical call for service, and then using appropriate tiers of response (ALS, BLS, or alternative transportation) could reduce response times to those who are seriously ill. Their research also noted that this resulting decrease in lights and siren responses could improve road safety for both civilians and emergency responders. Each of these benefits reflects elements of the overall mission of pre-hospital care delivery.

Development of the Medical Priority Dispatch System.

The evolution of standardized methods of applying pre-arrival instructions and call prioritization through the late 1980s and 1990s eventually led to the development of the Medical Priority Dispatch System (Zachariah, 1995), which is currently used by the SBFD. The Medical Dispatch Priority System (MPDS) is a commercially available product that was originally developed by Dr. Jeff Clawson, and is now controlled by the National Academy of Emergency Medical Dispatchers (NAEMD) (Cady, 1999). Clawson & Dernocoeur (2000) outline the elements of the system to include protocols that are standardized and validated, a systematic approach to questioning callers and identifying appropriate resource response, quality assurance with medical oversight, communication styles that are consistent in wording and format, and continuing education for dispatch personnel. Currently, there are 2,500 agencies worldwide are using MPDS in 20 countries and in 16 different languages (Taylor, 2003).
Of all the elements of MPDS, the cornerstone is the use of medically based protocols along with comprehensive and consistent oversight of protocol compliance. Clawson, Cady, Martin, and Sinclair (1998) state that the elements of strong protocol development and quality oversight will ultimately determine if the program will be a benefit to the community through both medical effectiveness, and protection from liability. These two elements are critical in ensuring that decisions made by the dispatcher are based on solid medical research, not simply through their intuition or personal bias.

In studying the accuracy of emergency medical dispatcher’s decisions to override protocol driven response code recommendations, Clawson, Olola, Heward, Scott, & Patterson, (2007) found little connection between a dispatcher’s personal perception of the urgency of the patient’s condition and the actual clinical condition of the patient. Their research supports the concept that protocol-based decisions were more accurate than the subjective determinations made by the dispatchers.

*Usage patterns of ALS resources in pre-hospital EMS systems.*

Although traditional approaches to EMS dispatching generally include sending available ALS resources to every medical call for service as quickly as possible, there is evidence that not every call for service that is received through a 9-1-1 system is an ALS level medical emergency. In a study of pre-hospital dispatch triage accuracy in an urban EMS system, Stratton (1992) found that nearly 35% of the calls studied that were dispatched as ALS did not meet the criteria for ALS field intervention when assessed by responders. Similar findings by Camasso-Richardson, Wilde, and Petrack (1997) showed that 61% of the ambulance transports studied in pediatric cases were considered medically unnecessary.
In studying these trends, Brown and Sindelar (1993) found that patients with publicly funded medical insurance were 5 times more likely to use emergency ambulance services when it was not medically necessary than those with private insurance. They also noted that 20% of the observed misuse was related to alcohol intoxication. Billittier et al. (1996) found that lack of alternative transportation was the most common reason for patients selecting ambulance transport when it was medically unnecessary. This reason accounted for 39% of the patients in their study who were unnecessarily transported by ambulance.

There is also evidence ambulance transportation is often used more out of convenience than medical necessity. In a study of the appropriateness of ambulance use, Richards and Ferrall (1999) found that 47% of the patients studied who called for ambulance transport for a non-emergency event had access to alternative transportation to the hospital. Similarly, Camasso-Richardson et al. (1997) found that although lack of alternative transportation was cited by 52% of the patients in their study who called for an ambulance unnecessarily, 34% of these patients returned home by private vehicle.

The impact of response times on patient outcome

The unwarranted use of EMS resources as noted here reduces the overall efficiency of the pre-hospital care delivery system. When finite resources are committed unnecessarily to minor medical calls, the response time to significant medical emergencies is increased (Reilly, 2006). Pepe, Bonnin, Almaquer, Prentice, and Mattox (1989) found that patient survival rates are measurably lower in systems where paramedic/ALS resources are sent to every medical call for service. This was because these limited ALS resources were frequently preoccupied with minor medical
emergencies, thereby increasing response times to more life threatening emergencies. Research on the clinical effect of delayed response for field intervention shows a notable connection between increased response times and increased patient mortality rates (Hendrika, et al. 1997; Roberts & Timmin 2007).

Even small delays in treatment can be significant. White, Hankins, & Bugliosi (1998) found that delays in ALS intervention as short as one minute will have a measurable negative impact on a cardiac arrest patient’s response to early defibrillation and discharge survival. Pell, Sirel, Marsden, Ford, & Cobbe (2001) further determined that survival rates from out of hospital cardiac arrest could be doubled by reducing the 90th percentile response times for EMS resources from 14 minutes to 5 minutes.

In evaluating both medical and trauma emergencies, Blackwell & Kaufman (2002) found that response times of greater than 5 minutes resulted in a mortality risk that was 3 times greater then when the response time was less than 5 minutes. For response time intervals greater than 5 minutes, the mortality risk curve remained generally flat.

Cummins, Eisenberg, Hallstrom, & Litwin, (1985) found similar results using the performance variables of CPR and defibrillation to measure cardiac patient survival to hospital discharge rates. Their research of cardiac arrest patients noted survival rates of 37% when CPR was initiated within 5 minutes of collapse, and followed by defibrillation within 10 minutes. When CPR was delayed beyond 5 minutes and defibrillation beyond 10 minutes, the survival rate of patients in the study was reduced to zero.

In addition to improved patient outcomes, there is evidence that shorter EMS response times contribute to decreased healthcare costs. In evaluating cardiac arrest survivors, van Alem, Dijkgraaff, Tijssen, & Koster (2004) found that the lowest healthcare
costs per survivor were associated with the shortest time to defibrillation. These savings were realized through faster overall recovery times and less time spent in intensive care units. The research also notes that the avenue by which the defibrillation is administered will depend on the resources in the community. They suggest that in addition to dispatch prioritization and effective resource deployment, wide distribution of automated external defibrillators throughout the community may also affect a similar outcome.

The effect of call prioritization and response times

There is a growing body of research indicating that the use of call prioritization systems can be a valuable tool in managing EMS resources availability and improving response times. By evaluating the severity of each medical call for service and sending resources accordingly, response times are reduced for those calls where minutes can have a measurable impact on patient outcome (Woollard, 2003). One study using a decision-tree prioritization system implemented in Atlanta and Fulton County Georgia showed a reduction in the average response times of EMS responders by over 35% (Slovis, Carruth, Seitz, Celia, & Elsea, 1985).

Similar studies of an EMS call prioritization system applied in an urban environment found that ALS resource usage was decreased by 40.2% when compared to sending an ALS resource on every 9-1-1 call for service (Curka, Ginger, Pepe, and Sherrard, 1993). The study findings note that such a decrease in ALS usage on low acuity calls for service improves the likelihood that these resources will be available when urgently needed.

In studying of the effect of priority dispatch systems on patient outcomes, Nicholl, Coleman, Gareth, Turner, and Dixon (1999) found that when priority
dispatching was not used, approximately 1 in 3 patients in their study with high-priority medical conditions received response times of over 8 minutes. Their research indicates that these response times could have been reduced and clinical outcomes improved if a call prioritization system had been used to focus resources on the priority calls. Although a small number of the calls studied were under-prioritized, their research concluded that the clinical benefits of a faster response time that could be accomplished through call prioritization would far outweigh the potential risks of under-prioritization.

The risks to patient care associated with under-prioritizing calls should not be overlooked, however. Research by Kuisma et al. (2004) analyzed the mortality rates associated with the longer response times received with calls that were initially identified as a lower priority, and therefore responded to without lights and siren. Their research focused on lower priority calls where the patient ultimately expired. The findings in the lower priority calls analyzed showed that the fatalities would likely have been avoided in 1.3% of the calls, and possibly could have been avoided in as many as 32.9% of the calls by sending the resources with lights and siren. The research stresses, however, that by discontinuing call prioritization, the number of lights and siren response would increase threefold. Their assessment of the impact of this increase included a substantial decrease in resource availability, which would lead to longer overall response times.

This same point was emphasized Persse, Key, Bradley, Miller, & Dhingra (2003), who concluded that assigning BLS resources to non-life threatening medical calls and reserving ALS resources for life threatening emergencies was associated with improved patient outcomes in cases of cardiac arrest. Their research found that prioritized systems were able to produce faster response times to the patient when compared to systems that
send ALS resources on every call for service. The improved response times were identified as a significant factor in the improved patient outcomes.

Another concern in sending a full response with lights and sirens to every call for service without regard to the patient’s complaint or condition is the increased potential for traffic collisions. As mentioned in the background of this research, responding to the scene of an emergency is the second most common type of duty associated with firefighter fatalities (Tridata Corporation, 2002). Although a lights and siren response decrease response times, research by Hunt et al. (1995) found that lights and sirens response in an EMS setting resulted in an average time savings of only 43.5 seconds when compared to a response without lights and siren. Their research concluded that the decision to use lights and siren response to a scene or during transport should be based on protocols that include an appraisal of the patient’s overall condition.

The sensitivity and reliability of call prioritization systems

The benefits of a prioritization system’s ability to improve response times also carry with them the possibility of inaccurately triaging the call, and sending an insufficient response for the emergency at hand. In their research on the effectiveness of priority dispatch systems, Nicholl et al. (1999) note that “no priority system can be expected to identify such cases without wrongly identifying some calls as life threatening emergencies, and also failing to identify some possible life threatening emergencies” (p. 75).

From a broader perspective, however, the potential for inaccuracies in prioritizing calls should be put in context with their level of impact on overall patient outcomes. In their study of 738 cases of pre-hospital cardiac arrest, Flynn, Archer, & Morgans (2006)
found that dispatchers correctly assigned a maximal ALS response to 76.7% of the cases using MPDS protocol. Of the remaining 173 cardiac arrest calls that were not coded as such, 83.7% of them still received an ALS response, but without first responders that are normally sent to cardiac arrests.

Overall, their research found no significant reduction in survival upon arriving at the hospital among those cardiac arrests that did not receive the maximal ALS response. The research also noted that although changing some response determinants could reduce the number of false negatives, it would also result in additional ALS responses, which would potentially increase response times. By including additional response level types to receive maximal ALS response, ALS resources would run an average of 9 additional calls per day, with only about 3% of these patients being in cardiac arrest.

Another study by Shah, Bishop, Lerner, Fairbanks, & Davis (2005) focused on the ability of 21 MPDS dispatch codes to correctly identify patients with low-acuity illness. The research identified 11 codes that met their validation criteria of correctly identifying low acuity patients with an accuracy rate of 90% or greater. From the perspective of patient care, the research also notes that 95% of the patients assigned a low priority dispatch code also met the study’s low acuity definition.

The fact that the remaining codes did not meet the validation criteria raises concerns about their potential to recommend an inadequate response, although none of the remaining codes had an accuracy rate of less than 80%. Even with these shortfalls, the researchers note that the MPDS offers the potential for improving multiple aspects pre-hospital care delivery. However, they emphasized the need for further validation of dispatch codes to reduce the potential of under-responding resources.
In analyzing the impact of committing limited ALS resources to low acuity medical calls, Reilly (2006) found that in many cases, the use of MPDS actually over-triages calls where a patient may have symptoms similar to those found in cardiac emergency. The focus of the research was to identify all calls that were dispatched as cardiac in nature based on MPDS criteria. Patients associated with these calls were then tracked in the emergency department to establish their final clinical diagnosis at discharge. In 71.4% of the cases, the patient’s diagnosis was determined to be non-cardiac related. Statistically, this would indicate a predictive value of the MPDS for determining cardiac emergencies of only 28.6%, which suggests that ALS resources are dispatched unnecessarily in a majority of calls identified as cardiac in origin.

Similar findings in research by Flynn, Archer, & Morgans (2006) and Palumbo, et al. (1996) note an apparent overuse of ALS resources on chest pain calls due to the use of MPDS protocols. Collectively, their research concludes that the resulting decrease in ALS resource availability is not necessary, and could have a negative overall impact on patients care due to the resulting prolonged response times for ALS intervention.

This tendency to over-triage certain call types may be a byproduct of the systems design. The rules and protocols established as part of the MPDS advocate treating all complaints of chest pain in patients over the age of 35 as though they are having a heart related emergency until proven otherwise (Clawson & Dernocoeur, 2000). The rationale for this level of response is to ensure that the resources sent will accommodate the patient’s worst-case scenario of a heart attack.

Although this rationale offers a safeguard against under-triaging, Deakin, Sherwood, Smith, & Cassidy (2006) found in their study of the accuracy of MPDS that
only 1 of approximately 18 patients complaining of chest pain were actually diagnosed with acute coronary syndrome by the receiving hospital. This evidence supports previously mentioned research that suggests that although MPDS can improve certain aspects of an EMS response system, modifications could be made to improve its efficiency.

Summary

Collectively, the information gathered through the literature review indicates that prioritizing EMS calls for service in the dispatch center can increase the availability of EMS resources for use on more serious medical calls. The literature also provides evidence that this increase in resource availability is associated with shorter response times, leading to more efficient and effective patient care. Furthermore, studies of EMS usage patterns by citizens reveal that not all 9-1-1 calls for service are actual medical emergencies that would require the deployment of ALS resources. These findings support the rationale behind allocating limited resources based on the patients needs.

It is clear, however, that prioritization systems have the potential to under-triage and over-triage, both of which could have a negative impact on the EMS delivery system. While the majority of the research reviewed suggests that these potential deficiencies are outweighed by the overall benefits of prioritization, it is clear that further research and development of such systems could increase their efficiency. Although the use of a call prioritization system by itself will not ensure that adequate resources are present in a community, it has demonstrated effectiveness in appropriately allocating them for maximum benefit to the patient.
Dispatcher Prioritization

Procedures

The first phase of this applied research project was a review of existing literature on the topic. The reviewed materials consisted of a selection of textbooks, journal articles, periodicals, news sources, databases, and Internet articles. These sources came from the National Fire Academy’s Learning Resource Center (LRC), ProQuest® on-line database, related books in print, and various Internet sites. Information from these sources was used to refine the direction of the research, and validate its findings.

Evaluative research methods were used to establish answers for the four questions posed by this research. The focus of the first research question was to determine the impact that using MPDS had on ALS resource availability in the SBFD. The first step in answering this question was to analyze all EMS calls for service through the department’s computer aided dispatch (CAD) system for various time periods in calendar year 2007 and 2008. Data from each call processed through SBFD’s CAD is stored in a database using Standard Query Language (SQL) format, and is maintained by the City’s Information Technology (IT) department.

At the request of the author, the IT department assigned a technician to extract call data from the CAD database for calendar year 2007. The technician organized the data for purposes of analysis using Crystal Reports® database report building software. From this data set, all EMS calls that had been identified by SBFD dispatchers as having the two lowest acuity levels based on MPDS criteria were isolated. These calls fall into categories labeled Alpha or Bravo level by MPDS (see Table 1).

Although a call for service may be classified as Alpha or Bravo level according to MPDS criteria, the decision to send BLS versus ALS resources on these calls, and the
response time standard that they will adhere to is established by SBFD and local medical control officials. This process consists of analyzing data produced through MPDS’s quality assurance (QA) procedure, which includes a standardized scoring system to measure protocol compliance. Once the QA scores for a specific call type reach 90% or greater, and the medical director for San Bernardino County agrees that modifying the response level is appropriate, the response level type is modified accordingly.

For the purpose of this research, call types that had been through this approval process were referred to as approved Alpha and Bravo calls. The response levels for approved Alpha and Bravo level calls are outlined in Table 1. At the time this research was conducted, there were also Alpha and Bravo levels for specific medical complaint categories that had not yet been through the approval process. Non-approved Alpha and Bravo response level types received the same level of ALS response from SBFD as higher priority calls.

Once the approved Alpha and Bravo level calls were extracted from the data set, they were refined a second time to eliminate any approved Alpha or Bravo level calls that may have actually received a full ALS response from SBFD. Although SBFD units do not normally respond on approved Alpha level calls, there are circumstances where it may occur. Because this research question focuses on the amount of time SBFD resources are not assigned to Alpha and Bravo calls, it was necessary to exclude these anomalies.

The remaining approved Alpha and Bravo level calls in the data set were totaled. Each call represented a period of time during calendar year 2007 that an SBFD ALS resource would have been out of service while dealing with the incident had MPDS not
been used. Because a retrospective approach was used in this research, and because SBFD resources did not actually respond to these calls due to the active use of MPDS, data was not available that would have established exactly how much time was spent on each call. Therefore, a benchmark time frame was used for this research. This time frame was established by identifying the length of time that SBFD units normally spend on a medical call for service. This is commonly referred to as time on task, and is referenced as such throughout this research.

For this research, time on task was measured from the time that a responding SBFD unit received an EMS call for service to the time that the same unit went back in service after completing the call. Each of these calls was a lights and siren response. Time on task could include elements such as response to the scene of the emergency, patient care and transport to the hospital, equipment clean up, and restocking of supplies used on the specific call for service.

The duration of the time on task was determined by analyzing all EMS calls for service that the SBFD responded to in calendar year 2007. These calls for service were then calculated mathematically to determine the time on task duration that 90% of the calls in the data set fell within. This process established a 90th percentile time on task duration of 32.8 minutes. For the purposes of this research, this figure was rounded to 33 minutes, which was the value used as the time on task benchmark for research questions one and two.

The next step for this question was to multiply the final number of approved Alpha and Bravo calls by the 33-minute benchmark time on task. This established the approximate number minutes that SBFD ALS resources did not have to respond to
approved Alpha and Bravo level calls due to the use of MPDS. The total number of minutes was then divided by 365 to establish the average number of minutes per 24-hour work shift that units were kept in service and available through the use of MPDS.

The minute value for this data set was then calculated as a percentage of the total minutes spent on all EMS calls for service during calendar year 2007. The total minutes spent on EMS calls was established by counting all EMS calls where an SBFD ALS resource was dispatched to the call, went en route, and arrived on scene during calendar year 2007.

The total time spent on these calls for service was calculated by multiplying the 33-minute benchmark time on task by the total number of calls for service, and dividing by 365. The impact of MPDS use was then measured in terms of the percentage of increase or decrease in minutes per 24-hour shift that SBFD resources were allowed to remain available because they did not respond to approved Alpha and Bravo level calls for service.

The second research question involved measuring the impact of MPDS on response times for SBFD ALS resources responding to patients with higher priority medical symptoms. For this research, calls referred to as higher priority were those that were categorized as Charlie, Delta, or Echo level calls by SBFD dispatchers using MPDS. Lower priority calls referred to those calls that were categorized through MPDS as Alpha and Bravo level.

The first step in this analysis was to identify all approved Alpha and Bravo level calls for service that occurred during a 3-month period beginning October 1, 2007 and
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ending December 31, 2007. Computer aided dispatch (CAD) records were analyzed to
determine the exact date and time of each call for service in that data set.

Additional CAD records were then reviewed to determine if any higher priority
EMS calls for service that would require an SBFD ALS response occurred sometime
within the 33-minute benchmark time on task period of any of the initial Alpha or Bravo
calls. The higher priority calls for service also had to occur within the same response
district as the original Alpha or Bravo call to be included in this data set.

For each additional higher priority call that met the above criteria, the research
assumed that without MPDS, the SBFD ALS resource that normally serves the affected
response district would have been unavailable to respond due to their response to the
original lower priority call. Consequently, the SBFD resource that would have responded
to the subsequent higher priority call would be coming from another response district,
creating a longer response time for this call.

An estimate of the impact that this scenario would have had on response times
was established by analyzing CAD data from calendar year 2007. The data set consisted
of 19,765 EMS calls for service that SBFD ALS resources responded to. This data was
refined further to isolate the response times for EMS calls that occurred within each of
San Bernardino City’s 12 fire response districts. For each EMS call for service in each
individual district, the elapsed time from the receipt of the call in SBFD’s dispatch center,
to the arrival of the first SBFD ALS resource was captured. These were then calculated to
establish the 90\textsuperscript{th} percentile total response time that occurred in each district.

This data set was then analyzed in two ways. The first analysis included only the
SBFD ALS resource assigned to the district where an EMS call for service took place.
This was referred to as the primary ALS unit. Only response times for calls where the primary ALS unit was responding to call locations within their district, from a location within their district were included. This represented the optimum response time that could be achieved for that district, and was referred to as the in-district response time.

The second analysis included only those EMS calls where an SBFD ALS resource, other than the primary ALS unit, had to respond to the district where the EMS calls for service occurred. In most cases, this secondary ALS resource would be responding from outside the district where the call for service occurred. This represented the most likely response time scenario that would occur if the primary SBFD ALS unit was already committed to another call for service. This was referred to as the out-of-district response time.

The differences in these two response time scenarios were then put into context with the number of times secondary resources would have to respond into other districts in absence of MPDS. Each time a primary ALS unit would have been unavailable to respond to a higher priority call for service in their district due to a previous response to a lower priority call, it was assumed that the higher priority call would have received the out of district response time. Impact was then measured by any resulting increase or decrease in the response time to the higher priority call, and the number of higher priority calls that were affected by such change.

The third research question involved establishing the frequency in which the use of MPDS resulted in BLS resources being sent to calls where it was later determined that ALS intervention was indicated. Because this question focused on ALS versus BLS
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response, Bravo level calls were not included as they already receive an ALS response by the private ambulance company.

Because these BLS responses are handled by the City’s contracted private ambulance company, the author requested the assistance of the company’s clinical specialist in obtaining and evaluating data. Patient contact reports (PCRs) from every Alpha level call that received a BLS ambulance response without SBFD between November 1, 2007 and January 31, 2008 were collected for evaluation. The PCR forms contain specific clinical information including the patient’s chief complaint, medical history, medical assessment by the responding personnel, changes in condition during the call, vitals, and treatment provided (see Appendix A for PCR form example).

Each PCR was reviewed by the clinical specialist to determine if there were any indications that the call was incorrectly coded at the Alpha level, or that the patient’s condition warranted ALS care. Indicators of the need for ALS care were based on local protocol, and the patient’s condition as described on the PCR. Any unclear or incomplete documentation on the PCR was researched by the clinical specialist through interviews with the personnel who responded on the call. If further clarification was needed, the clinical specialist would contact the staff at the receiving hospitals regarding the patient’s condition upon arrival there. Information was also gathered from SBFD’s communication center to identify any of the calls that may have been miscoded to Alpha level due to dispatcher error.

Calls coded as Alpha level that were identified as warranting ALS intervention were then calculated as a percentage of the total number of Alpha calls reviewed. This percentage established the frequency in which the use of MPDS resulted in BLS
resources being sent to calls where it later determined that ALS intervention was indicated.

The final research question was answered by evaluating dispatcher compliance to MPDS protocol using two different approaches. The first approach required an analysis of SBFD quality assurance (QA) records to determine the proficiency level of SBFD dispatchers in following MPDS protocol. The QA process used to ensure protocol compliance includes a scoring system that is managed through a software-based product called AQUA™. This is a companion product to MPDS, and was developed by the same company. Through this system, a minimum of 25 calls per week are analyzed by the SBFD’s dispatch center supervisor, and scored against a standard rating criterion. The calls to be reviewed are randomly selected by the software system. The calls can include any one of the 31 MPDS patient complaint types, and may fall into any of the specific response level types.

Once the calls to be reviewed are determined, the dispatch supervisor obtains the telephone audio recording for each of the specific calls. These audio recordings are captured for every 9-1-1 call that is processed through SBFD’s dispatch center. Each recording contains the dialogue between the dispatcher and the 9-1-1 caller. The dispatch supervisor then listens to the recording, and follows along using the protocol scripts and key questions that the dispatcher should have used. Scores of up to 100% for accuracy in protocol compliance are then assigned based on the dispatcher’s compliance to specific benchmark components of MPDS call processing, which then establishes an overall score.
For the purpose of this research, a report was generated using the MPDS quality assurance scoring system that reflected the average protocol compliance score for the SBFD dispatch center using this. The time period for the report was from October 1, 2007 through December 31, 2007, which coincides with the time period used on research question three. Dispatcher proficiency was measured on a scoring range of up to 100% accuracy. For this research, the minimum score needed to be considered proficient was 95%.

The second approach for this question included an analysis of observations found through the process of answering research question three. Part of the procedure for answering question three included evaluating the accuracy of response level assignment by the dispatcher for the 231 calls in the data set. Calls where the response level type did not match the patient’s condition were evaluated by the private ambulance clinical specialist and SBFD’s dispatch supervisor. This evaluation consisted of a review of the PCR, SBFD’s CAD data, and the audio recordings from the call. Through this process, calls where the dispatcher did not follow protocol were identified.

Because the calls evaluated for the first approach of this research question were randomly chosen through the standard QA process, this second data set did not necessarily focus on the same calls for service. Therefore, evaluating dispatcher accuracy through the calls evaluated in research question three provided a second view of their proficiency in following established protocols. The second approach used to evaluate dispatcher accuracy used different parameters than the standard quality assurance method described in the first approach. However, like the first approach, the findings could be quantified using a scoring range of up to 100% accuracy.
To establish this score, the number of calls in the data set used in research question three where the response level type assigned by the dispatcher matched the patient’s condition was determined using the methodology described. The number of correctly assigned response level types was then calculated as a percentage of the entire data set. As with the quality assurance scores used in the first approach to this research question, the overall accuracy score in this data set would have to be at least 95%. This would be the benchmark to establish the proficiency level of SBFD dispatchers in applying MPDS for the purposes of this research. Scores below that level would indicate that the dispatchers were not proficient.

The data retrieved through the two approaches to this research question provided a view of dispatcher proficiency through two separate methods of analysis. Although both approaches used accuracy scores of 95% or greater were to establish proficiency, a comparison of the scores was also made to determine consistency between the scores and scoring methods.

Assumptions and limitations

The SBFD’s response configuration follows the traditional approach of strategically placing fire stations throughout the city is such a way that response times, and particularly driving times, are minimized. Although emergency resources are housed in these fire stations, they are not necessarily in the fire station at all times. In addition to responding to calls for service, other reasons that units could be out of their station, their district, or out of service completely include training and prevention activities, apparatus maintenance, or other administrative duties. At the time this research was conducted,
there was no practical means to track these activities or the exact location of SBFD resources at the time of that a call for service was dispatched.

Because of this, estimates of district response times were established using historical data calculated to the 90th percentile, and do not represent the actual response times for each call used. However, because the data used is recent, and represents time intervals from a substantial number of EMS calls for service, the research results should still accurately represent system trends.

In addition, SBFD resources did not respond to the approved Alpha or Bravo level calls for service that were used in this research because MPDS was in use. As such, there was also no practical mechanism to identify which SBFD resource would have responded if MPDS was not used, or what their actual response time would have been. Therefore, historic data was used to approximate response times for specific scenarios. Although a 90% fractal calculation was used to illustrate the most common times, the actual response times could have been slightly longer or shorter for some responses.

Another limitation of the research methodology stems from the lack of an available tracking mechanism that can follow the medical status and progress of each patient from arrival at the emergency room through discharge. Having access to such records in a user friendly form, such as a database, would allow for a more comprehensive analysis of the impact of pre-hospital systems on patient discharge rates. Although such records are kept independently by the receiving hospitals, there was no practical mechanism to obtain and organize them in a context that would be useful in this research. In absence of such data, the research made use of studies outlined in the
literature review to establish the most likely impact that faster or slower response times could have on patients.

Definitions

Automatic External Defibrillator (AED): “A device that automatically analyzes the heart rhythm and, if it detects a problem that may respond to an electrical shock, that permits a shock to be delivered to restore a normal heart rhythm” ("Automated External," 2008).

Computer Aided Dispatch (CAD): A computerized system that assists in processing emergency calls for service in public safety dispatch centers. The system usually captures the specific details of every call processed, and stores it in a database for review.

Emergency Medical Dispatch (EMD): “Reception and management of requests for emergency medical assistance in an EMS system” (Clawson & Dernocoeur, 2000, A.76).

Medical Priority Dispatch System (MPDS): “Medically approved, unified system used by medical dispatch centers to dispatch appropriate aid to medical emergencies” (Clawson & Dernocoeur, 2000, A.79). Part of the EMD system used by SBFD dispatchers to appropriately allocate emergency and non-emergency resources to calls for service that are processed through SBFD’s emergency communications center.

Response level type: The identifier used to reflect the severity of an EMS call for service. For the purpose of this research, response level types include the designations of Alpha, Bravo, Charlie, Delta and Echo (see table 1).
Total response time: The elapsed time that begins when a 9-1-1 call for service is received at SBFD’s dispatch center, and ends when the first emergency resource arrives on scene.

Results

Through a review of the data gathered, and with the supporting information found in the literature review, answers to the specific research items were established.

The impact of MPDS use on ALS resource availability.

During calendar year 2007, the SBFD dispatch center processed a total of 22,006 EMS calls for service where an emergency resource (private ambulance and/or SBFD) was dispatched, went en route to the call location, and arrived on the scene. Of these calls, 1,568 were approved Alpha level calls for service, and 673 of them were approved Bravo level calls for service. The Alpha and Bravo response level was determined by SBFD dispatch using MPDS. These approved Alpha and Bravo responses account for a total of 2,241 calls for service.

Based on the use of MPDS by the SBFD, each approved Alpha and Bravo call for service represents a response by the private ambulance company that serves San Bernardino City. No emergency resources from SBFD responded to any of these calls for service. Therefore, the duration of each approved Alpha and Bravo call represents a period of time where ALS resources from SBFD were available for other department related activities. If MPDS had not been used, these resources would have been unavailable due to their response to the Alpha or Bravo call.

To calculate the impact of this, the benchmark time on task of 33 minutes established for this research was multiplied by the 22,006 total EMS calls for service that
SBFD ran in calendar year 2007. The product of this calculation was then divided by the 365 days in the year, which yielded a total of 1,989.6 minutes per 24-hour period. This represented the average number of minutes in a 24-hour period that SBFD ALS resources would have been unavailable while assigned to calls for service if MPDS had not been used during calendar year 2007.

The same 33-minute time on task benchmark was then multiplied the 2,241 total approved Alpha and Bravo level calls responded to by private ambulance only during calendar year 2007. The product of this calculation was then divided by the 365 days in the year, which yielded a total of 202.6 minutes per 24-hour period. This represents the average number of minutes in a 24-hour period that SBFD ALS resources were not assigned to approved Alpha and Bravo level calls due to the use of MPDS.

The 202.6 minutes was then calculated as a percentage of the 1,989.6 minutes that SBFD ALS resources would have been unavailable had MPDS not been used. The result was 10.2%, which represents the average amount of increase in SBFD ALS resource availability per 24-hour period due to the use of MPDS.

The impact of MPDS use on ALS response times to higher priority EMS calls.

The impact that MPDS use had on response times for SBFD ALS resources was measured in terms of how often the system freed up these resources for higher priority medical calls when they would have otherwise been committed to lower priority calls. Between October 1, 2007 and December 31, 2007, a total of 102 higher priority calls for service (Charlie, Delta or Echo level) occurred within 33 minutes following a lower priority call (approved Alpha or Bravo level), and within the same response district as the initial lower priority call.
The 33-minute window represents the benchmark time on task that was established for this research. Its application to this research question suggests a high probability that the primary ALS resource responding to the initial lower priority call would not have been available for subsequent calls for at least that amount of time. Therefore, a secondary resource would have to respond to the subsequent higher priority call from a location that would likely be outside the district where the call occurred.

Based on data retrieved from SBFD’s CAD system for calendar year 2007, the 90th percentile response time for secondary SBFD ALS resource to respond to a district other than their assigned district was 10.2 minutes. During the same period, the 90th percentile total response time for the primary ALS resources responding from within their assigned district to EMS calls that were also located within their assigned district was 7.7 minutes. This represents a 32.5% decrease in response times when primary SBFD ALS resources are available to respond to calls for service that are located within their assigned district.

Therefore, the data indicates that between October 1, 2007 and December 31, 2007, a total of 102 patients in this data set with higher priority medical symptoms received an ALS resource that arrived up to 32.5% faster due to the use of MPDS. This finding indicates that the use of MPDS by SBFD shows a measurable, positive impact on ALS response times for patients with higher priority medical symptoms.

The Frequency of BLS resources being assigned to ALS level calls

During the research study period of November 1, 2007 through January 31, 2007, a total of 231 calls for service were categorized as Alpha level through the use of MPDS by SBFD dispatchers. Of these Alpha level calls, 187 (81%) resulted in an ambulance
transport to a hospital, while the patients in the remaining 44 incidents (19%) ultimately refused care and ambulance transportation. The 187 ambulance transports included some of the calls for service that were initially coded as Alpha level, but were later upgraded to ALS based on additional factors. These calls and the circumstances surrounding them will be identified later in this section.

Patient contact reports (PCRs) and CAD records from SBFD were reviewed for each of the 231 Alpha level calls to determine if the patient’s condition matched the criteria for a BLS response per MPDS protocol. The MPDS criteria for BLS response matched the patient’s condition in 216 of the 231 Alpha calls, indicating that the response was appropriate for the patient’s condition in 93.5% of the calls.

In the remaining 15 calls for service identified as Alpha level, the response was upgraded from the initial BLS response to ALS based on the patient’s condition. This represents 6.5% of the 231 Alpha calls evaluated.

Ten of the 15 calls that were upgraded based on the patient’s condition as observed by the responding BLS unit, or because of additional information provided to the SBFD dispatcher after the initial dispatch as an Alpha call. The remaining 5 calls were upgraded to ALS at the request of the base station hospital when they were advised of the patient’s condition by the responding BLS ambulance. In each case, the reason for the upgrade was that the patient’s condition met local protocol criteria for ALS level assessment or prophylactic treatment. Through the analysis of PCRs, responding crew reports, and contacts with the receiving hospital, the research found no indication of a change in patient condition upon arrival to the receiving hospital in any of the 15 upgraded calls.
The proficiency of SBFD dispatchers in applying MPDS protocol.

The final research question evaluated the proficiency of SBFD dispatchers in complying with MPDS protocols. A total of 249 EMS calls for service were reviewed between October 1, 2007 and December 31, 2007 as part of SBFD’s ongoing quality QA process as described in the procedures section. The calls that were evaluated were randomly selected by the software-based portion of the QA system.

Each call selected for evaluation represents 1 of 31 different patient complaint types, each of which is scored separately. The average protocol compliance score for all patients complaint types used in this data set was 99.96%. The highest compliance score for any one patient complaint type was 100% and the lowest was 99.41% (see Appendix B for entire QA report). These scores represent protocol compliance levels well above the minimum 95% level needed to achieve the minimum proficiency level established for this research.

The second evaluation component for this research question involved a review of the 231 Alpha level calls used in answering research question three. Through the process of reviewing each PCR, it was determined that 10 (4.3%) of the calls for service had been incorrectly processed through the MPDS system by SBFD dispatch.

This resulted in a MPDS code categorization for these calls that was not arrived at through proper protocol application, and therefore did not properly reflect the patient’s medical complaint. However, in only 1 of the 10 incidents did this result in a response categorization change from BLS to ALS. For this single incident, the proper response would have been a Bravo level, which is an ALS ambulance without SBFD, using a 11 minute, 59 second response time standard. In the remaining nine calls, these errors did
not change the response categorization from the Alpha level, as they only involved the nature of the patient’s chief complaint, not the severity. Had these nine calls been processed per protocol, the level of response would still have been BLS, which was also determined to be appropriate based on review of the PCR for each call.

Based on the total 231 calls reviewed, the 10 calls that were in error would bring the overall proficiency rate to 95.7%. As established in the procedures section, the benchmark used to establish minimum proficiency in protocol compliance was scores of 95% or greater in the two areas analyzed. The research found that in both areas, SBFD dispatchers demonstrated a high level of proficiency in following MPDS protocol compliance by meeting or exceeding the minimum compliance scores established for this research.

Discussion

Analysis of the data collected offered insight into several aspects of SBFD’s priority dispatching system, including specific strengths and weaknesses. The research provides evidence that an effective EMD system that includes priority dispatching can have a positive impact on the quality of care delivered through a pre-hospital EMS program. At the same time, there is also evidence that priority dispatch systems, including the MPDS system used by SBFD, are not without the potential for errors.

The research found that by using MPDS, the availability of SBFD resources was increased by 10.2%. Although this is a positive finding, the change was less than the 40.2% decrease in ALS responses found by Curka et al. (1993) in their research of similar call prioritization systems. This finding offers insight into the potential that this
system has for SBFD if steps were taken to expand its use. Suggestions for doing so will be made in the recommendations section of this research.

Increasing resource availability has other positive service delivery implications as well. The SBFD is responsible for delivering multiple emergency services in addition to EMS, such as fire suppression, technical rescue, and hazardous materials response. In order to be effective in providing these services, it is important that critical resources are not pulled out of the system to respond on non-emergency calls for service when it can be avoided. Reducing resource availability in this fashion reduces the efficiency of these services, and may decrease the safety of operations for responders. If adequate resources cannot be assembled in a timely fashion, it may not be possible to accomplish critical incident objectives in a safe and effective manner. The inability to meet such objectives may also place additional community members at risk unnecessarily.

With so much at stake, it is not responsible for an emergency service organization to simply allow the 9-1-1 caller to dictate how resources will be used. As noted in the literature review, a significant number of EMS calls for services received through the 9-1-1 system are not life threatening emergencies (Camasso-Richardson et al. 1997; Richards & Ferrall, 1999; Stratton, 1992). Therefore, the research provides solid rational for fire and emergency service leaders to analyze their response patterns closely, and actively look for ways to ensure that their resource deployment matches the level of the emergency at hand. As this research shows, using dispatchers to prioritize calls for service can be an effective approach to accomplish this.

Managing resource availability in this fashion also offers a positive effect on important non-emergency fire department activities. These activities include fire
prevention inspections for certain occupancy types, training, and public education on risk reduction. Although these activities are non-emergency in nature, they are essential for meeting the overall mission of the SBFD. These activities are more likely to take place when resources are not tied up unnecessarily with lower priority medical calls for service. In addition, these activities do not require that resources be taken out of service, which means that critical resources are still available for emergency calls while these activities are taking place.

Another positive aspect of MPDS use found through this research was its effect on lights and siren responses and traffic safety. Although measuring this effect was not within the scope of this research, the fact that the research showed a decrease in the number of lights and siren responses due to the use of MPDS is worthy of note.

The decrease in lights and siren responses was evident in two areas. As noted in the research, lights and sirens are not used on Alpha level calls. Therefore, the 1,568 approved Alpha level responses noted in this research represent calls where responders and citizens were not exposed to the hazards of lights and siren responses. Second, although approved Bravo responses receive an ambulance responding with lights and siren, this response level type would have also received an additional SBFD resource with lights and siren had MPDS not been used. Therefore, MPDS use resulted one less vehicle responding with lights and siren on 673 Bravo level calls for service in 2007.

As noted by Hunt et al. (1995), these lights and siren responses generally do not provide for substantial improvements in response times. Therefore, the practice does not offer a substantial improvement in EMS delivery. Research by Thakore et al. (2002) also notes that lights and siren responses place emergency responders and citizens at greater
risk of traffic related injuries and fatalities. Therefore, although the safety implications of
lights and siren responses were not precisely measured in this research, it is reasonable to
conclude that the decrease in such responses due to MPDS use in San Bernardino City
has the potential to improve traffic safety for both emergency responders and civilians.

The analysis of approved Alpha and Bravo calls in this research also called
attention to the remaining Alpha and Bravo level calls that have not yet been approved.
As mentioned in the procedures section, each of these response level types has the
potential for a modified resource deployment, but until they have gone through the
approval process, they still receive a full ALS lights and siren response by SBFD and the
responding ambulance.

Through the process of this research, it was determined that that if SBFD were to
work toward the approving all remaining Alpha and Bravo level calls for service, the
number of approved Alpha calls would increase by about 21%, and approved Bravo calls
would increase by about 42%. Based on the method used to determine the impact of
MPDS on resource availability, the research suggests that there would be a
commensurate increase in SBFD resources availability for other emergency calls or
activities, as well as a decrease in response times to higher priority calls.

The findings of the second research question provided additional insight into the
potential impact that MPDS use had on response times and patient care. Looking at
higher priority patients alone, the research found that MPDS use reduced ALS response
times by 32.5%. This is very close to the 35% response time reduction found through the
use of similar systems in Atlanta and Fulton County Georgia (Slovis et al. 1985), which
were cited in the literature review.
The 32.5% response time reduction found in this research validates other reviewed research performed by Reilly (2006), Pepe et al. (1989), and Nicholl et al. (1999) which found that sending ALS resources unnecessarily on minor medical calls increases overall ALS response times. Other research found in the literature review provides evidence that these longer response times result in measurably lower patient survival rates (Hendrika, et al. 1997; Roberts & Timmin 2007; Woollard, 2003).

Although this research question focused on the reduction in response times that was realized through MPDS use, a connection between this reduction and related data found in the literature review illustrates its potential impact on patient care. The 32.5% decrease in response times resulting from SBFD’s MPDS use equates to approximately 2.5 minutes. There is evidence that even relatively short durations such as this is still medically significant.

Research by White et al. (1998) found that delays as short as one minute can decrease a patient’s response to defibrillation and discharge survival. Similarly, research by Blackwell & Kaufman (2002) indicates that response times greater than 5 minutes could increase mortality risks three-fold over response times less than 5 minutes. Although SBFD’s response time standard of 6 minutes, 59 seconds on 90% of their EMS calls is outside this specific 5-minute window, the point is clear that every minute that a response time can shortened is in the best interest of the patient.

This potential capacity for MPDS to reduce response times must also be placed in balance with the potential for the system to recommend BLS resources when the patient’s condition warrants ALS. As the research showed, this occurred in 6.5% of the Alpha level calls evaluated. A review of the PCRs for each of these calls found that the level of
ALS intervention was generally at a prophylactic level, and there was no indication that the patients’ condition changed significantly throughout the transport or upon arrival at the receiving hospital. Nonetheless, each incident represents the potential for a negative impact on the patient, and therefore should be viewed as significant.

As noted in the literature review, there is evidence that sending a BLS resource to an ALS level call for service may have a detrimental impact on patient care, including potential delays in ALS intervention and increased mortality rates. Research by Kuisma et al. (2004) found that in 1.3% of their cases studied, fatalities could have been avoided had ALS resources responded with lights and siren rather than the BLS response that was sent due to the use of call prioritization. However, their research concludes that had a call prioritization system not been in place, the impact on resource availability would have likely resulted in longer response times overall. Similar findings in research by Flynn et al. (2006) showed that although changing some response determinant codes to allow for maximal ALS response could reduce false negatives, it would increase the number of ALS runs by an average of 9 per day, thereby increasing response times to other critical calls.

This dilemma captures the focus of this research. A connection between a patient’s death and an inadequate resources response is not difficult to make. However, a connection between a patient’s death resulting from a lack of available ALS resources due to unnecessary deployments on other calls can be more difficult to identify. As this research found, the incidences of increased resource availability for higher priority calls due to MPDS use occurred at a greater frequency than incidences of inadequate resource responses. According the research by Persse et al. (2003), this scenario represents a high
likelihood of faster response times and improves patient outcomes. As such, the research findings suggest that overall, the use of MPDS by SBFD has a positive impact on patient care.

The research also found that overall, SBFD dispatchers showed a high degree of proficiency in applying MPDS, with overall protocol compliance scores of greater than 95%. This is a positive finding, as protocol compliance and quality assurance are considered the cornerstone of MPDS (Clawson, et al. 1998). Placing these high accuracy levels in the broader context of how priority dispatching may improve patient care illustrates how dispatchers can play a key role in pre-hospital care delivery. This observation supports the findings of research by Maggiore (1997) and Thakore et al. (2002) which concluded that dispatchers can and should be included as part of the overall EMS delivery system.

As noted in the literature review, however, it is unlikely that any call prioritization system can operate without occasionally identifying a patient’s condition incorrectly (Nicholl et al. 1999). The research also identified areas where the proficiency of SBFD dispatchers could make improvements. Through the review of 231 PCRs from Alpha and Bravo calls, the research found that dispatchers deviated from protocol on 4.3% of the calls. In all but one case, the impact of this deviation was minor, resulting in an incorrect evaluation of the patient complaint, but no change in the level of response. The remaining case would have changed the response to a Bravo level, which would have received an ALS ambulance with a maximum 12 minutes response, and no SBFD resource.

The notable aspect of these deviations was that nearly half of them appear to have been a result of the dispatchers own interpretation of the significance of certain elements
of the patient’s medical history. These interpretations were not part of MPDS protocol, and the deviations did not result in any specific benefit to the patient, as the dispatcher may have believed it would have. As discussed in the literature review, research by Clawson et al. (2007) found that there is little connect between a dispatcher’s perception of the severity of the patient’s condition and the patient’s actual clinical condition. As such, any inclination by dispatchers to interject their observations as a reason to override protocol should be discouraged.

Recommendations

The findings of this applied research project suggest that the use of MPDS by the SBFD contributes to the efficiency of pre-hospital EMS delivery in the City of San Bernardino. There is also evidence that the use of MPDS occasionally results in BLS resources responding to calls where ALS intervention is indicated, although the frequency of these occurrences is relatively low. The research also suggests that by using MPDS, the response times to higher priority medical calls can be reduced, which is a potential clinical benefit for the patient. Each of these findings represent an avenue for taking positive steps toward making the SBFD a highly efficient asset to the community it serves. To that end, several recommendations should be considered, based on the findings of this research.

1. The SBFD should continue using MPDS as an integral part of their EMS response system. Evidence from this applied research project shows that there are advantages to the system that would likely translate to a positive clinical benefit for citizens needing emergency pre-hospital medical care in the City of San Bernardino.
2. The SBFD should continue developing their uses for MPDS with a goal of maximizing the efficiency of all SBFD resources. Currently, BLS ladder truck companies do not respond without another SBFD ALS resource responding with them. By expanding the applications of MPDS, certain response level types could be identified where the second ALS unit would be eliminated. This would further increase ALS resource availability, and reduce the number of emergency apparatus on the road with lights and siren. Future plans for the SBFD should also include the addition of ALS ladder truck companies and two-person ALS response units placed in strategic areas. This opens additional opportunities to use MPDS to balance call loads across the city by appropriately modifying response time criteria and resource need based on the immediate needs of the patient.

3. The SBFD should take the necessary steps to place the remaining non-approved Alpha and Bravo level response level types into approved status. The research found that by doing so, the number of approved Alpha calls would increase by about 21%, and approved Bravo calls would increase by about 42%. Based on other findings of this research, the effect of approving these additional response level types for a modified response would likely result in a measurable increase in SBFD resource availability, and a further decrease in response times to higher priority medical calls for service.

4. The SBFD should continue performing regular quality assurance checks of the MPDS to ensure strict protocol adherence by SBFD dispatchers. As the research showed, the potential for sending an inadequate response is much higher when dispatchers stray from established procedures. As with any complex system, a
lack of quality oversight can result in a slow drift away from critical procedures. This can occur so subtly that in many cases, it goes unnoticed until there is a significant failure in the system. Maintaining quality assurance is a proactive step that can be taken to prevent this from occurring.

5. In order to maintain effectiveness, the SBFD should conduct regular evaluations of their MPDS using some of the same methodology used in this applied research project. There are a number of variables that could impact the effectiveness of this system. These include changes in call volume, geographic shifts in call density, changes in the city’s demographics, and attrition of personnel who work within SBFD’s current system. Such changes are inevitable over time in any community. Therefore, it would be irresponsible to assume that any efficiency demonstrated through research today will still be valid in years to come.

6. The SBFD should expand its use of the Echo level call category in MPDS. As discussed in the research, Echo level calls provide a mechanism to respond unconventional resources to the most critical emergencies. Since Echo level calls denote full cardiac arrest in most cases, sending the closest resource, even if it is BLS, in addition to the closest ALS resource could benefit the patient. For the SBFD, this could include sending alternate response vehicles including BLS aerial ladder trucks, and chief officers who are equipped with basic BLS equipment and an AED.

7. The SBFD should coordinate with the San Bernardino City Police Department (SBPD) to incorporate appropriate law enforcement resources into the Echo level category. This could be accomplished by training SBPD field officers in CPR and
the use of AEDs, and placing AEDs in each patrol vehicle. If a SBPD unit happens to be close to the location of an Echo level cardiac arrest, they could respond, and potentially provide life-saving intervention through CPR and rapid defibrillation while ALS resources are en route.

The configuration of SBPD lends to this approach in two ways. First, the dispatch centers for SBPD and SBFD are co-located in the same room and operate off of the same CAD system. Therefore, the receipt of an Echo level cardiac arrest by SBFD dispatch could quickly be passed on to SBPD dispatch, who would then send any available SBPD unit that may be close to the call location. Second, because all SBPD patrol vehicles are tracked by the dispatch center using GPS and real-time mapping, it would be relatively easy to determine if an officer equipped with an AED would be closer to an Echo level call than any other responding resource. Responding in this fashion could result in increased survival rates for patients in cardiac arrest.

8. The SBFD should institute a mechanism for electronic EMS reporting. Such reporting should include detailed information about the patient’s chief complaint as it was reported to the dispatch center, the patient’s condition upon arrival of EMS resources, the treatment administered, and the patient’s status upon arrival at the receiving hospital. Ideally, such a system would link to the receiving hospitals records management system to allow for continuous tracking of the patient’s condition up through their final disposition. Clearly, a system of this type would be a powerful tool that would facilitate a more comprehensive assessment of the effectiveness of the local medical delivery system.
9. The SBFD should share the findings of this research with other agencies in their region to promote the use of priority dispatching as a tool to improve pre-hospital care delivery. As mentioned in the background and significance section, other EMS providers in the San Bernardino CA area have been reluctant to pursue a priority dispatch program. This is in spite of the fact that the call volume increase in these areas over the last decade has been similar to what SBFD experienced when they recognized the need to initiate MPDS. Much of this reluctance stems from a concern about liability, and the potential for under-responding. Although the research indicates that the potential for under-responding exists, it also offers compelling evidence that the alternative of sending a full response to every call may have even broader negative effects. Hopefully, by seeing the measured results of SBFD’s experiences with priority dispatching, other agencies will reevaluate the potential benefits of implementing similar systems in their jurisdiction.
References


(Medicinenet.com, 2008)


APPENDIX A

SBFD Patient Contact Report (PCR) Sample
APPENDIX B

Quality Assurance Report for SBFD Dispatch Center for October 1, 2007 through December 31, 2007

### Distribution:

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*Total Cases Reviewed: 258  *Total Cases Entered: 258

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