March 2014

EMS Modernization Project Report

Contra Costa County

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# Contra Costa County EMS Review

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EXECUTIVE SUMMARY

Fitch & Associates was engaged to complete this “EMS Modernization Project.” The name does not adequately describe what was encompassed in the review. The intent of this process is to understand the current EMS System functions and performance levels and to identify trends to guide recommendations for optimizing future EMS System operations.

The overriding consideration of the project was to focus on what is best for the patients and the community. Given that there is a limited amount of resources, how can they be utilized to provide the greatest benefit?

This summary will identify the key findings and trends and the associated recommendations to position the EMS System to address and respond to healthcare changes, financial challenges, and proven clinical care service delivery.

Healthcare Reform

The passage of Affordable Care Act (ACA) by Congress in 2010 set in motion a number of changes to healthcare delivery systems in America. The healthcare reform changes initiated by the ACA and other reform activities have an immediate and long-term impact on EMS and out-of-hospital care. Unfortunately, it is too soon to understand the ultimate challenges and opportunities that will result. It is not unreasonable to expect that the availability of a 24/7 clinically trained mobile workforce of the EMS System may seen as an important component in the coordinated delivery of healthcare services.

EMS systems throughout North America are expanding the roles of caregivers in collaboration with healthcare systems to provide alternative solutions to matching individual healthcare needs with the most appropriate and affordable services.

Recommendations – Healthcare Reform

The key recommendation is to ensure that the County and the agencies involved in the Contra Costa County EMS system recognize that there will be continuing changes in the healthcare delivery systems resulting from ACA and other external influences. The System and its participants must be able to embrace and adapt to new opportunities including:

- Alternative delivery of healthcare services such as nurse advice lines,
- alternative destinations for patients,
- treat and release or refer,
- chronic disease monitoring,
- follow-up with patients discharged from hospitals,
- provision of transfer center operations,
- continuous patient care reporting, and
- assisting with patient navigation through the healthcare systems.
It is likely that as healthcare systems mature and are fully responsible for all of an individual’s healthcare needs, there will be opportunities for the agencies involved in EMS to provide alternative services and receive funding that is not based solely on transport.

**Financial Issues**

Revenue received for patient transports is flat while the costs of providing the service are escalating. There has been a significant shift in the payer mix, with a much larger percentage of EMS patients being covered by governmental programs (i.e. Medicare and Medi-Cal) and fewer covered by commercial insurance providers. The impact of these trends is that it will be difficult to increase revenue for patient transports in the future.

The EMS Agency maintains a dependable funding source from Measure H, but is seeing a decrease in revenue from other sources, particularly the Hospital Preparedness Program grant funding. Expenses continue to climb as the agency’s responsibilities expand and additional funding will be required to implement essential needs for information system improvements for data collection and the implementation of a continuous patient care record standardized for all healthcare agencies.

First responder agencies are fiscally challenged and in many areas have had to decrease capabilities by closing fire stations and reallocating resources. This has an impact on the System’s ability to provide prompt first response to medical emergencies in some areas of the County.

Healthcare facilities are also experiencing financial pressures which may result in further consolidation of healthcare providers and the closing of some facilities. This has the potential to impact the cost of EMS by lengthening transport times to more distant facilities and slowing the transfer of care from ambulance crews to emergency department personnel.

**Recommendations – Financial Issues**

The financial trends identified previously are expected to continue. The recommendations are based on reallocating existing funds from low value/high cost activities to those activities that benefit the patients and the System’s financial viability. Again, the overriding aim is to focus efforts on activities that benefit the patients and community health while eliminating activities that do not provide a significant contribution. The following are some of the recommendations aimed at improved financial viability.

- Initiate a fee for patients who receive treatment at the scene, but decline transport, and increase ambulance charges to levels comparable with other northern California counties.
- Reduce System costs and relocate funds to higher priority activities. Mechanisms to achieve cost reductions include:
  - the consolidation of ambulance response zones into three,
  - establishing consistent response time and staffing requirements for the entire county,
  - lengthening response times requirements by 60 seconds,
- eliminating QRV units,
- allowing first response to be provided at the BLS level
- dispatching first responders only on calls where they are likely to be beneficial to the patients

**Community Health and Clinical Care**

Ultimately, the EMS System in Contra Costa County and all of its participating agencies must focus on what is best for the patient and the community. Clinical research has clearly identified activities that save lives and reduce morbidity. The most successful are based on a continuum of care provided by bystanders, dispatch, first responders, ambulance services, and receiving facilities.

Contra Costa County has robust programs for trauma, STEMI (heart attack), stroke, and resuscitation. These efforts should be expanded and the System to be prepared to implement further systems approaches to care of the acutely ill or injured patients.

To achieve the greatest benefits, it is necessary to focus on the weaker areas of clinical care delivery and reallocate some of the savings achieved in cost reduction to areas to improve community health and patient care.

Clinical research in EMS has called into question the benefit of existing response time standards and the importance of advanced life support (ALS) services. Recent research has indicated that patient outcomes improve with response times less than four minutes. There is not an appreciable change in patient outcome with response times between four and 14 minutes. Literature also reveals that ALS has a limited impact on patient outcomes and there is no evidence that first responder ALS is beneficial. Demonstrated life-saving interventions can be provided by EMTs or Advanced EMTs with access to automated defibrillation.

**Recommendations – Community Health and Clinical Care**

The recommendations are aligned with the continuum of care and systems approach concepts and include:

- Establish a single robust medical dispatch center that is capable of identifying when first response is needed, providing pre-arrival instructions, categorizing calls, transferring callers to advice resources, promptly dispatching first responders and ambulances, and potentially diverting callers/patients to more appropriate resources. The goal is to efficiently and effectively match the patient needs with the most appropriate resources.
- Create the infrastructure to implement a continuous patient care record that amalgamates patient care documentation from dispatch, first responders, ambulances, and receiving facilities.
- Improve the information system infrastructure to be able to monitor real time activity within the County and to facilitate collection of information to demonstrate performance and quality. The platform will facilitate research into all aspects of the EMS delivery system.
 Greatly expand the capabilities of bystanders and community members through aggressive CPR training, dissemination of public access defibrillators, community education on prevention and recognition, and enlistment of volunteer first responders.

 Ensure collaboration of medical dispatch, the ambulance providers, and healthcare systems to take advantage of opportunities to work together to improve community health and patient outcomes by introducing alternative services that will be catalyzed by healthcare reform initiatives.

 Modify system requirements and activities based on evidence from research. New treatments, pharmacology, and procedures are being continuously being revealed as having a positive impact on patient outcome. Likewise, the efficacy of current practices may be discredited. An EMS System must continuously be prepared to implement changes to keep abreast of the evolving standards of care.

Summary

The Contra Costa County EMS system has delivered effective care to the sick and injured. Changes in the roles of EMS System participants are anticipated and all of the providers must be able to respond to these challenges and opportunities.

This report identifies areas where costs can be reduced without negatively impacting the patients and the community. This will define a more efficient EMS System and allow for investment in improvements to benefit the patient and strengthen the financial positions of the participants.
INTRODUCTION

Fitch & Associates (Fitch) was retained by Contra Costa County (County) to conduct an EMS system design utilizing a “greenfield,” or “whiteboard” approach. These methodologies begin with no preconceptions that the current system is doing what it should be doing or whether it is producing the greatest benefit for the community it serves. The study was completed using data and information provided by the County EMS Agency, municipal communications centers, fire first responders and the Agency’s medical transportation contractor, in response to the Consultant’s Information and Data Request (IDR). Additionally, extensive stakeholder consultations produced hundreds of pages of written notes, as well as documents offered at these meetings.

The information reflected in this study was collected over the period from April 1, 2013 through February 1, 2014. It encompasses a three-year period of County data, unless otherwise noted. The Consultant’s internal database, as well as industry guides, and industry standards, in addition to state and federal regulations, were used as benchmarks for the policies, procedures, processes and operations cited in this report.

The data presented in this report has potential bias, based on the limitations and/or accuracy of respondent-submitted data. While data accuracy is a primary objective, the results are only as precise as the data submitted or that which is contained in client and client-contractor databases.

Project Scope

It has been a decade since significant changes to Contra Costa County’s EMS were implemented. Since the redesign of the EMS system, monumental events have transpired that have a direct impact on EMS and the provision of ambulance services.

The recent fiscal crisis faced by the United States, and particularly California, has affected key agencies involved in EMS. Medical response by the fire services is being challenged and for the first time the involvement by fire agencies in EMS is being questioned.

Concurrently, fundamental changes are occurring in healthcare delivery in the U.S. Healthcare providers and payers are consolidating and developing coordinated care models that increase patient transportation needs and modify the number of type of facilities involved in patient care.

The broad issues have specifically impacted Contra Costa County EMS with the potential closure of a major acute care hospital (Doctors Medical Center in San Pablo), the closure of multiple fire stations, and the looming potential of eliminating additional fire stations.

Furthermore, while the County has authority to oversee performance of its emergency 9-1-1 ambulance services, it has little ability to monitor and ensure adequate performance of basic life support (BLS),
interfacility, and critical care ambulance transportation. The integral role that these services play in modern EMS and healthcare delivery systems warrants governmental oversight and the ability to ensure operational and clinical performance.

This report identifies strategic objectives to assist in making public policy decisions for the future delivery of EMS and community healthcare to residents and visitors of Contra Costa County. The following are examples of the objectives are addressed:

1. Ensure EMS system is able to effectively respond with appropriate resources to incidents of acute illness or injury
2. Establish mechanisms to achieve appropriate response to disasters, multiple casualty incidents, and other events requiring additional surge capacity of providers.
3. Implement procedures and protocols that, based on evidence, demonstrate results beneficial to patient outcomes
4. Match EMS and healthcare resources with patients’ illnesses, injuries, or social needs
5. Incorporate the continuum of care concept in the County’s system to include prevention, early identification, resource allocation, care delivery, transportation, and definitive care
6. Prepare system for modern out-of-hospital initiatives for EMS providers such as, treat and release, alternative destinations, referral to most appropriate resources, community paramedicine, etc.
7. Expand funding sources and allocate resources to further accomplish system objectives

**County Description**

The County of Contra Costa, California was incorporated in 1850 as one of the original 27 counties of the State of California, with the City of Martinez as the County Seat. It is one of the nine counties in the San Francisco-Oakland Bay Area. The County is the ninth most populous county in California, with its population reaching approximately 1,066,096 as of January 1, 2011.

With a land mass of 720 square miles, Contra Costa County's physical geography is dominated by the bayside alluvial plain, the Oakland Hills–Berkeley Hills, several inland valleys, and Mount Diablo, an isolated 3,849-foot (1,173 m) peak at the north end of the Diablo Range of hills. The geography lends itself to three distinct county areas: East County, Central and West County.

The economy in Contra Costa County is represented by agriculture, heavy industry (oil refineries, chemical plants and steel), service industry and housing.
System Overview

Designated by the County Board of Supervisors, Contra Costa Health Services (CCHS) serves as the local emergency medical services (EMS) agency. The principle functions of a local EMS agency (LEMSA) are specified in Health and Safety code. The Contra Costa LEMSA is a mature and highly functioning program with well-established trauma, cardiac, stroke, STEMI (ST-elevation myocardial infarction) systems of care. The department has comprehensive policies, procedures and processes for system medical control, including those for dispatch, patient destination, patient care, patient safety and quality improvement. The department has an active community outreach program, EMS for Children’s program as well as disaster preparedness and response activities.

Within the County, the EMS system includes:

- **Fourteen Communications Centers:** Ten primary Public Safety Access Point (PSAP) communications centers are designated law enforcement including Contra Costa County Sheriff’s Department and California Highway Patrol, three secondary PSAP’s for fire and ambulance and the private emergency service ambulance center (Sacramento).
- **Three Emergency Ambulance Providers:** American Medical Response (AMR), Moraga-Orinda Fire District (MOF) and San Ramon Valley Fire Protection District (SRVF).
- **Twelve Non-emergency Ambulance Providers:** American Medical Response, Bay Medic Ambulance, Arcadia Ambulance, California Ambulance, Falck Northern California, Falcon Critical Care Transport, Medic Shuttle, NorCal Ambulance, ProTransport-1, Rural/Metro of Northern California, Inc. and Westmed Ambulance.
- **Eleven Fire Agencies:** Concord Federal Fire, Crockett Fire, Contra Costa County Fire, East Bay Regional Park Fire, East Contra Costa Fire Protection District, El Cerrito Fire, Moraga-Orinda Fire, Pinole Fire, Richmond Fire, Rodeo - Hercules Fire and San Ramon Valley Fire
- **Four Helicopter (air ambulance/rescue) Providers:** California Shock Trauma Air Rescue (CALSTAR), REACH Air Medical Services, California Highway Patrol and East Bay Regional Park.
- **Nine Acute Care Facilities/Hospitals:** Contra Costa Regional Medical Center, Doctors Medical Center - San Pablo, John Muir Medical Center - Walnut Creek Campus, Kaiser Medical Center – Antioch, Kaiser Medical Center – Richmond, Kaiser Medical Center - Walnut Creek, John Muir Medical Center - Concord Campus, San Ramon Regional Medical Center and Sutter/Delta Medical Center.
- **Twenty-two Law Enforcement Agencies:** Antioch Police Department, Brentwood Police Department, California Highway Patrol, Clayton Police Department, Concord Police Department, Contra Costa Sheriff’s Department, East Bay Regional Park Police, El Cerrito Police Department, Hercules Police Department, Kensington Police Department, Lafayette Police Department, Martinez Police Department, Moraga Police Department, Orinda Police Department, Pinole Police Department, Pittsburg Police Department, Pleasant Hill Police Department, Richmond Police Department San Pablo Police Department, San Ramon Police Department and Walnut Creek Police Department
- **Three EMS Training Programs**: Contra Costa College, Los Medanos and Mt. Diablo Adult Education
- **Twenty-nine Continuing Education Providers**

Fitch appreciates the opportunity to conduct this project and offers thanks to the numerous stakeholders: first responder units, transporting agencies, County employees, as well as the other fire departments and other organizations and individuals that assisted in the completion of this report.
METHODOLOGY

Fitch & Associates used an eight-phase approach to accomplish the proposed scope of work for the Project. Phase 1 launched the project; Phases 2-3 consisted of comprehensive data collection; Phases 4-6 involved data analysis and benchmarking; and Phases 7 and 8 are complete with the final presentation of this report. A description of each of the eight phases follows.

1. Project Initiation. The consultants initially met with County leadership by phone and subsequently, in person to identify project goals and initiate the project activities.

2. Materials and Data Collection. Data was provided by the County EMS Agency, municipal communications centers, fire first responders and its medical transportation contractor, in response to the Consultant’s Information and Data Request (IDR) through a secure web based server.

3. Onsite Interviews & Direct Observation. The consultant team site visited the County and conducted interviews with leaders of key functions as well as external stakeholders and employees.

4. Stakeholder Input: Through the use of stakeholder meetings, system participants from various entities within the EMS system had an open forum to engage in dialogue about the system, understand history, identify best practices, and highlight opportunities for the future. The breadth of those consultations is detailed below.

5. Data Compilation and Client Input. Data from onsite interviews and the Information and Data Request were compiled and organized for analysis. Emerging questions were directed to agency or County leadership, as appropriate.

6. Industry and County Benchmarking. System benchmarks were identified and incorporated, where available. In addition, the agencies enabling legislation and practices were reviewed.


8. Report Results: Draft Results and Public Comment. A draft report is compiled and submitted for public review and comment. Stakeholder presentations are conducted followed by incorporation of public comment leading to a Final Report.

The eight phases of this process result in comprehensive design concepts that draw from qualitative and quantitative data, research and stakeholder input. This structured process allows questioning of the status quo, including services and the manner they are delivered, in addition to performance requirements, roles, goals and visions for the future. All options are available for consideration, and it allows for potential fundamental changes in funding, structure, and activities.
Description of Stakeholder Consultations

The Consultants embraced extensive stakeholder consultations in order to gain a full, 360-degree view of Contra Costa County and engage them in the creative development of the future system. This involved the following methods:

- **Public Input**: The Consultants initiated an email address, posted on the CCC EMS website, to gather public input. This outreach was promoted through County media releases. All email responses were kept confidential and accessible only by the Consultants.

- **Weekly CCC EMS Telephone Conferencing**: Regular conferences were conducted with CCC EMS staff, Director, former Director, Medical Director and members of the Fitch team, and with CCHS leadership and others on an ad-hoc basis.

- **Individual Stakeholder One-on-One Meetings**: During four on-site consultations, Fitch conducted approximately 50 individual meetings with stakeholders.

- **Communications Centers**: The CCCSD primary PSAP, three fire/ambulance secondary PSAPs and AMRs Regional Communications Center in Sacramento were observed along with individual leadership interviews.

- **First Responder Agencies/Chiefs and Senior Leadership**: The consulting team met with eight of eleven first responding agencies represented by Fire, EMS and Battalion Chiefs.

- **Ambulance Providers**: All emergency ambulance service providers gave input via one-on-one and group consultations. Non-emergency providers attended a CCC EMS sponsored meeting.

- **Prehospital and Fire Union Representatives**: One-on-one, in group meetings and attending design workshops input was solicited from union members.

- **Healthcare Providers and Acute Care Facilities**: Eight of the nine acute care facilities were visited by the Fitch team. Representative senior, acute care and/or Emergency Department leadership provided input from all facilities.

- **City/Town Leadership & Elected Officials**: Elected officials and city managers from across the County were provided input via meetings and telephone conference calls.

- **County Board of Supervisors**: Fitch met with each Supervisor individually or at facilitated meetings, several times during the review.

- **Payers**: Leadership from the County Health Plan and a major private health plan participated in information gathering and stakeholder meetings.

- **LAFCO**: Fitch met with, presented to and gathered input from the Contra Costa County Local Agency Formation Commission.

- **EMCC**: Fitch representatives attended and presented at three County Emergency Medical Care Committee meetings.

- **Surrounding LEMSAs**: Several bordering LEMSA Directors were solicited for input and design concepts.

- **Medical Organizations**: Fitch met with and gathered input from the Alameda-Contra Costa Medical Association (ACCMA) and California American College of Emergency Physicians (ACEP) leaders.
• Government Officials and County Health Authorities: Individual and small group meetings were convened with key program, health system and governmental officials throughout the County.
• System Design Workshops: Two four-hour System Design Workshops were conducted, for interested stakeholders.
• Others as requested: Several ad-hoc interactions were conducted by telephone or in person (i.e., EMS Data Consultant, PulsePoint App Developer, and citizens).

The range of these stakeholder consultations embraced virtually all aspects and touch-points in the County pre-hospital care delivery system.

Data Analysis to Define Incident Zones

The primary function of the EMS system is to respond to acute medical events and provide assistance and transport to the sick and injured. The design and operation of the EMS system is dependent upon understanding the demand on a geographical and temporal basis. This section provides the results of an extensive analysis of data in the Contra Costa EMS system in order to identify the resources required to meet demand responsively, and to create a framework for effectively monitoring the system’s performance.

Quantification and Distribution of Demand

The first step is to quantify the demand and determine where the incidents occur. Manually placing calls on a map becomes overwhelming very quickly because the geography becomes overrun with calls (See Figure 1). In addition, manual placement gives no sense of the temporal distribution of calls. In order to create maps of call demand that are intelligible and interpretable, the Ontario Municipal Benchmarking Initiative, OMBI, derived an algorithm to automate the establishment of Urban (high risk), Suburban/Rural (low risk), and Remote (negligible risk) call behavior. Fitch & Associates used proprietary software that refines the OMBI methodology for the analyses in this report.
There are three steps to determine Urban (high risk) and Suburban/Rural (low risk) incident zones:

1. Use the predetermined political boundaries of Contra Costa County as the mapping area.
2. Import the historical data for demands for service onto this map.
3. Create a grid of one-kilometer (1km) squares that covers the area to be evaluated. For all squares in the 1km grid, the analysis counts the number of incident locations that fall within each square. For each 1km square, the analysis also determines the number of incidents that fall within the eight adjacent 1km squares in the grid. This methodology removes the artifact or potential that a singular address, such as a nursing home, can affect a square to such a degree that it becomes Urban (high density demand) without truly exhibiting high-density demand over the whole square.

The outcome of this process results in the map of incident zones presented in Figure 2 below:

- **RED**: Urban Incident Zones—two calls per square kilometer per month with at least half the adjacent square kilometers having the same number of calls per month.
- **GREEN**: Suburban/Rural Incident Zones—at least one call per square kilometer every six months with at least half the adjacent square kilometers having the same number of calls per month.
- **No Color**: Remote Incident Zones—less than one call per square kilometer every six months.

Fitch used different suburban/rural criteria for EMS than for the fire system in an attempt to better reflect transition areas between the Urban and Remote zones.
Notwithstanding the lower threshold used to define Suburban/Rural EMS call zones, the calls in the county-defined rural areas (outlined in blue) behave more like Remote areas as defined in our analysis, with less than one call every six months per square kilometer.

The first observation is that the EMS call volume behaves predominantly Urban throughout. Where there are EMS calls in the system there is enough risk that coverage has to be predominantly urban in nature. Some of the areas currently defined as Rural have enough call volume to include pockets of Urban-type risk and need to have special coverage and response time requirements established. The subsequent recommendations and analyses will focus on two levels of risk areas (high risk in the Urban/Suburban and low risk in the Remote).

The second observation is that there are three very distinct zones. This means that each zone has to have its own surge capacity because the zones are too far apart to allow for resource sharing.

**Covering the Risk**

Once the risk areas are established, covering risk entails creating drive zones around strategic points on a map that represents the possible posting locations. An example of the drive zones surrounding a single location is demonstrated in Figure 3.
Obviously, the longer the drive time, the more area can be covered so one station covers more risk (geographic area of calls) but the coverage is achieved at a lower performance (longer response times) level.

The current system allows the contracted ambulance provider 11 minutes and 45 seconds to arrive on scene 90 percent of the time outside of Richmond. In our modeling we attribute 45 seconds for the turn out time and calculate risk coverage needs, based on allowing up to 11 minutes driving to the scene.

Table 1 summarizes the results of the analysis with an 11-minute drive time requirement. The modeling identified optimal locations for the risk coverage. These may, or may not, be viable posting locations for ambulances, but indicate the general areas that produce the greatest levels of coverage.

The “PostCapture” column quantifies how many incidents would be responded to within the 11-minute drive time, if an ambulance was based at the proposed location and was available to respond to all calls originating within its coverage area. The “TotalCapture” column accumulates the total incidents covered by each post and the final column represents a percentage of the total calls that would be covered.
Table 1. Risk Coverage Estimates for 11 Minute Drive Time

<table>
<thead>
<tr>
<th>Rank</th>
<th>Location</th>
<th>PostCapture</th>
<th>TotalCapture</th>
<th>PercentCapture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>near Forestview Mortgage Insurance Co/2990 Buskirk Ave. Walnut Creek. CA 49597</td>
<td>22161</td>
<td>22161</td>
<td>27.86%</td>
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<td>2</td>
<td>near Oriental Express/3237 Blume Dr. San Pablo. CA 94806</td>
<td>20531</td>
<td>42692</td>
<td>53.67%</td>
</tr>
<tr>
<td>3</td>
<td>near Double Dragon Restaurant/Double Dragon Restaurant</td>
<td>17942</td>
<td>60634</td>
<td>76.23%</td>
</tr>
<tr>
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<td>near Holiday Inn Express-Brentwood/350 Guthrie Ln. Brentwood. CA 94513</td>
<td>4508</td>
<td>65142</td>
<td>81.90%</td>
</tr>
<tr>
<td>5</td>
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<tr>
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<td>near Great Wall/1101 1st St. Lafayette. CA 94549</td>
<td>2934</td>
<td>72470</td>
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<tr>
<td>7</td>
<td>near Bart-North Concord-Martinez Station/Contra Costa</td>
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<tr>
<td>8</td>
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<tr>
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<td>near 168 Restaurant/Albany Hill Park</td>
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<td>10</td>
<td>near 4/950 Eden Plains Rd. Brentwood. CA 94513</td>
<td>663</td>
<td>77299</td>
<td>97.18%</td>
</tr>
<tr>
<td>11</td>
<td>near Peppino's Ristorante Italiano/Kirker Pass Rd</td>
<td>560</td>
<td>77859</td>
<td>97.89%</td>
</tr>
<tr>
<td>12</td>
<td>near Tosco Refining Co/Contra Costa</td>
<td>528</td>
<td>78387</td>
<td>98.55%</td>
</tr>
<tr>
<td>13</td>
<td>near Peking Palace Restaurant/Camino Tassajara. Danville. CA 94506</td>
<td>372</td>
<td>78759</td>
<td>99.02%</td>
</tr>
<tr>
<td>14</td>
<td>near Steam Train/Contra Costa</td>
<td>236</td>
<td>78995</td>
<td>99.32%</td>
</tr>
<tr>
<td>15</td>
<td>near Bethel Island Chamber of Commerce/Flamingo Mobile Manor. Bethel Island. CA 94511</td>
<td>181</td>
<td>79176</td>
<td>99.54%</td>
</tr>
<tr>
<td>16</td>
<td>near Fan Restaurant/Contra Costa</td>
<td>109</td>
<td>79285</td>
<td>99.68%</td>
</tr>
<tr>
<td>17</td>
<td>near Park and Ride-Bixler Rd/Contra Costa</td>
<td>52</td>
<td>79337</td>
<td>99.75%</td>
</tr>
</tbody>
</table>

This model indicates that the system would require six fully available resources for an 11-minute response time 90 percent of the time to all EMS calls. Since there are three distinct zones each zone has to have its own replacement factor. The consultant evaluated the additional resource requirement at 50 percent so the true number of fully available resources required is nine.

This same data and methodology was used to model the EMS system with a 12-minute drive time level to mitigate the risk as shown in Table 2. The question to be answered is how many incidents can be covered when ambulances are in the identified location within a 12-minute drive time?

Table 2. Risk Coverage Estimates for 12 Minute Drive Time

<table>
<thead>
<tr>
<th>Rank</th>
<th>Location</th>
<th>PostCapture</th>
<th>TotalCapture</th>
<th>PercentCapture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>near Bart-North Concord-Martinez Station/S150 Port Chicago Hwy. Concord. CA 94520</td>
<td>25636</td>
<td>25636</td>
<td>32.23%</td>
</tr>
<tr>
<td>2</td>
<td>near Uncle Chung's Szechuan/ 1</td>
<td>21127</td>
<td>46763</td>
<td>58.79%</td>
</tr>
<tr>
<td>3</td>
<td>near Carino's Italian Grill/ 2</td>
<td>15175</td>
<td>61938</td>
<td>77.87%</td>
</tr>
<tr>
<td>4</td>
<td>near Great Wall/ 3</td>
<td>8771</td>
<td>70709</td>
<td>88.90%</td>
</tr>
<tr>
<td>5</td>
<td>near Yang's at Canyon Lakes/5049 Lakeview Dr. San Ramon. CA 94582</td>
<td>3405</td>
<td>74114</td>
<td>93.18%</td>
</tr>
<tr>
<td>6</td>
<td>near Peppino's Ristorante Italiano/Contra Costa</td>
<td>2262</td>
<td>76376</td>
<td>96.02%</td>
</tr>
<tr>
<td>7</td>
<td>near Holiday Inn Express-Brentwood/ 6</td>
<td>899</td>
<td>77275</td>
<td>97.15%</td>
</tr>
<tr>
<td>8</td>
<td>near 168 Restaurant/ 7</td>
<td>797</td>
<td>78072</td>
<td>98.16%</td>
</tr>
<tr>
<td>9</td>
<td>near Oliva/3153 Andreaen Dr. Lafayette. CA 94549</td>
<td>480</td>
<td>78552</td>
<td>98.76%</td>
</tr>
<tr>
<td>10</td>
<td>near Bethel Island Chamber of Commerce/ 9</td>
<td>181</td>
<td>78733</td>
<td>98.99%</td>
</tr>
<tr>
<td>11</td>
<td>near S/ 10</td>
<td>172</td>
<td>78905</td>
<td>99.20%</td>
</tr>
<tr>
<td>12</td>
<td>near Steam Train/Contra Costa</td>
<td>155</td>
<td>79060</td>
<td>99.40%</td>
</tr>
<tr>
<td>13</td>
<td>near Michael's Ristorante Italiano/ 12</td>
<td>108</td>
<td>79168</td>
<td>99.53%</td>
</tr>
<tr>
<td>14</td>
<td>near John Muir National Historic Site/ 13</td>
<td>98</td>
<td>79266</td>
<td>99.66%</td>
</tr>
<tr>
<td>15</td>
<td>near Strings Restaurant Group/ 14</td>
<td>61</td>
<td>79327</td>
<td>99.73%</td>
</tr>
<tr>
<td>16</td>
<td>near 1/ 15</td>
<td>46</td>
<td>79373</td>
<td>99.79%</td>
</tr>
</tbody>
</table>

The system would need more than five fully available ambulances to achieve a 12-minute drive time response at 90 percent reliability. Since there are three distinct zones, each zone has to have its own replacement factor. Again, the Consultant evaluated the additional resource requirement at 50 percent. So, the true number of fully available resources required is seven to eight.
Covering Demand and the Net Difference

It is noteworthy that there are two components of covering demand. The first component is covering the risk (incidents occurring in a geographic area). Once risk is determined and the level of risk mitigation (response time) is determined, the units required can be calculated.

The second component of covering demand is quantifying the number of incidents that the system has to cover. A unit on a call cannot be used to cover risk, therefore the system has to distribute additional unit hours (hours of staffed ambulances) adequate to complete the incidents while retaining availability of units to cover the risk. This is captured in the following formula:

\[
\text{Total units required} = \text{units required to cover risk} + \text{units required to cover demand}
\]

Since the call volume is the same notwithstanding the risk coverage, the differential in required resources is dependent on the response time warranted to mitigate the risk.

By prolonging the response time by one minute, an average of 1.5 resources per hour can be saved. This translates to:

<table>
<thead>
<tr>
<th>units per hour</th>
<th>units per day</th>
<th>units per week</th>
<th>units per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>36</td>
<td>252</td>
<td>13,104</td>
</tr>
</tbody>
</table>

Multiplying the unit hour cost by the amount of unit hours saved demonstrates the potential system savings for a year by reducing the performance standard by a minute. The Consultant estimates that the annual savings for lengthening response times by one minute are in excess of $1.1 million per year.
EMS SYSTEM DESIGN PRINCIPLES

EMS systems in the United States are inherently local and heterogeneous, however, a joint position statement by the National Association of State EMS Officials (NASEMSO) and the National Association of EMS Physicians (NAEMSP) has offered this definition of an EMS System:

A comprehensive, coordinated arrangement of resources and functions, which are organized to respond in a timely, staged manner to targeted medical emergencies, regardless of their cause or the patient's ability to pay, and to minimize their physical and emotional impact.

The Emergency Medical Services Systems Act (1973) mandated that EMS programs address, plan and implement a systems approach for emergency response and care. The EMS Act identified fifteen recommended components to establish comprehensive regional EMS programs. The central thrust of the Act was to develop systems of emergency medical care that would decrease death and disability. Initially funded by Federal grants, the responsibility for providing EMS now rests with local governments.

Two fundamental documents have been released in the last decade, “Emergency Medical Services – Agenda for the Future” and “Rural and Frontier Emergency Medical Services Agenda for the Future: A Service Chief’s Guide to Create Community Support of Excellence in EMS.” The first was released by the National Highway Traffic Safety Administration (NHTSA) and the second by the Health Resources & Services Administration (HRSA). Both documents expand the traditional concept of EMS and are based on fourteen EMS attributes.

These attributes of an EMS system extend beyond the common perception of EMS consisting of emergency ambulance and first responder services. Both documents clearly express the future of EMS includes its integration with other healthcare providers and depends upon expanded community education and involvement. The former Administrator of NHTSA states, “As we look to the future it is clear that EMS must be integrated with other services and systems that are intended to maintain and improve community health and ensure its safety.”

This challenge is consistent with research findings and is being embraced in a few EMS systems within the Country. The EMS Agenda for the Future (EMSAF) clearly expresses the need for an expanded definition of EMS and focuses on more than responses to emergency medical events. The Vision Statement for EMS incorporates prevention, education, care, follow-up, and community health monitoring.

Emergency medical services (EMS) of the future will be community-based health management that is fully integrated with the overall health care system. It will have the ability to identify and modify illness and injury risks, provide acute illness and injury care and follow-up, and contribute to treatment of chronic conditions and
community health monitoring. This new entity will be developed from redistribution of existing health care resources and will be integrated with other health care providers and public health and public safety agencies. It will improve community health and result in more appropriate use of acute health care resources. EMS will remain the public’s emergency medical safety net.

The EMSAF Vision Statement suggests that these changes would occur from the “redistribution of existing healthcare resources and will be integrated with other healthcare providers and public health and public safety agencies.” The goal of this project for Contra Costa County is to reallocate available revenue to support this broader concept of an emergency medical system and out-of-facility care is consistent with the recognized national agenda for EMS systems of the future.

Clearly, EMS systems encompass broad-based community education and involvement, education centers for EMS providers, public health, community healthcare systems, medical direction, system coordination and oversight, public safety, first responders, and ambulance services. The array of system participants must work collaboratively to develop systems and centers of care based on evidence.

A “whiteboard” approach to EMS system design doesn’t discount past or present principles or structure. More so, a whiteboard takes what components work in a system and builds upon those successes, while stepping away from those that don’t. As the former Administrator of NHTSA states, “It is important, however, not to be held hostage to the past, but to look freely to the future.”

In simplest terms, an EMS system first determines the need, sends the proper response or responder, and provides the patient an appropriate disposition for care. Developed at the 2012 National Conference of State Legislatures, the “golden rule” of EMS is to get the patient to the “right place” at the “right time.” Building on this rule is the economic reality that the right place and right time must include service for the “right price.” Need, response, disposition and finance are all key concepts in the consideration of EMS system design. This EMS system matrix, blending dimensions from both the Haddon (public health) and Thomas (patient transport) Matrix, is illustrated below.
According to researcher, David R. Miller, “the future of EMS is indivisibly linked to how it is funded. In order to optimize the positive influence of EMS on community health, we must move to a system of finance that is proactive, accounting for the costs of emergency safety net preparedness and aligning EMS financial incentives with the remainder of the healthcare system.” The final core building block in EMS system design is financing. Given the challenging state of current EMS system financing, an entire section of this report is dedicated to the analysis of system financing.
EVIDENCE-BASED EMS

Evidence-based medicine has become the standard for change in healthcare yet; an evidence basis for EMS systems design is difficult as there is a lack of outcome based research, leading to a high variability of care and costs. The evidence of what works within EMS is coupled with the reality of public expectations and the need to respond promptly to the acutely ill or injured. Since the EMS system has a limited amount of resources, the design should ensure that the allocation of those resources be directed to operational and performance activities that provide the greatest benefit to patients.

Several prehospital interventions for medical patients actually save lives, specifically early cardiopulmonary resuscitation (CPR), early defibrillation for particular cardiac dysrhythmias, airway support using manual maneuvers, ventilations using bag-valve mask and blind insertion airway devices, epinephrine administration for anaphylaxis, and emergent medication administration and positive pressure support for acute asthma or chronic obstructive pulmonary disease exacerbation.

Interventions for many acute medical conditions are very similar, if not the same, in the prehospital and hospital settings, with less focus on rapid transportation, and greater focus on rapid intervention. Additionally early identification, and early access to hospital based care is also a consideration for non-trauma but time-critical cardiac patients where “time is myocardium,” stroke patients where “time is brain tissue,” patients needing access to burn center care, sepsis patients needing high-level care, as well as pediatric and high-risk maternal patients.

While clinical evidence may be lacking, an EMS system design should be based on emergency conditions, starting with four general categories of patient emergencies:

1. Airway/Respiratory,
2. Cardiovascular: Cardiac arrest, acute myocardial infarction,
3. Neurological and,
4. Trauma, specifically those critically injured.

Airway/Respiratory

Airway and respiratory emergencies are caused by a multitude of reasons based on the pathophysiology of obstruction or compromise. Objects in the airway; drug overdose (where the drug depresses respirations); anaphylaxis (an allergic reaction); chronic obstructive pulmonary disease (COPD); and asthma, to name a few.

Life-saving prehospital/first responder interventions for airway/respiratory emergencies include: Emergency Medical Dispatch (EMD), Heimlich maneuver, oxygen, epinephrine administration, CPAP, and nebulized albuterol.
Cardiovascular

For Sudden Cardiac Arrest (SCA) Eisenberg (2009) has consolidated extensive research, into a working model of the contributory and determinant factors that result in a successful resuscitation in any given community – Figure 5. xvi

Figure 5. Contributory & Determinant Factors in SCA

<table>
<thead>
<tr>
<th>Contributory Factors</th>
<th>Determinant Factors</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid Dispatch</td>
<td>Rapid Provision CPR</td>
<td></td>
</tr>
<tr>
<td>Aggressive Telephone CPR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI Program for Telephone CPR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community CPR Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Access Defibrillation (PAD)</td>
<td>Rapid Provision of Defibrillation</td>
<td>Successful Resuscitation</td>
</tr>
<tr>
<td>Cardiac Arrest Registry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI Program for Defibrillation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recording of Cardiac Arrests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical Direction</td>
<td>Interaction of CPR &amp; Defibrillation</td>
<td></td>
</tr>
<tr>
<td>Medical QI Program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recording of Cardiac Arrests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical Direction</td>
<td>Rapid Provision of Advanced Therapy</td>
<td></td>
</tr>
<tr>
<td>Medical QI Program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital Protocols for Hypothermia</td>
<td>Rapid Provision of Hypothermia</td>
<td></td>
</tr>
<tr>
<td>Prehospital Hypothermia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical QI Program</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The list of determinant factors is short. The effects of these five factors are the direct determinants of a successful resuscitation. The contributory factors exert influences that lead indirectly to improved chances of resuscitation. These five contributory factors became the basis for the chain of survival to improve the chances of survival in out-of-hospital cardiac arrest – Figure 6.

Figure 6. Chain of Survival in SCA xviii

Lifesaving prehospital/first responder interventions in SCA include: Airway support and protection, CPR, and automatic defibrillation (AED).
**STEMI**

In 2009, approximately 683,000 patients were discharged from U.S. hospitals with a diagnosis of acute coronary syndrome (ACS); however, community incidence rates for ST-elevation myocardial infarction (STEMI) have declined over the past decade.\textsuperscript{xviii}

Care of the STEMI patient follows a similar pathway as the chain of survival in SCA, which is in essence, rapid entry into a system of care. Cardiac care associations have established the “EMS to Balloon” time (E2B), a 30-30-30 rule, which takes the goal of achieving a 90-minute door-to-balloon time and divides it into three equal time segments. Each STEMI care provider (EMS, the emergency department, and the cardiac cath lab) has 30 minutes to complete its assigned tasks and "hand off" the STEMI patient to the next provider.\textsuperscript{xx}

Lifesaving prehospital/first responder interventions in STEMI include: EMD, instruction on aspirin administration, prehospital acquisition of 12-lead ECGs to identify acute STEMI, and rapid transport to a cardiac care facility, STEMI Alert.

**Neurological**

Stroke is the 4\textsuperscript{th} leading cause of death in the United States. Ranking 3\textsuperscript{rd} prior to 2008, a systems approach to stroke care, led by the American Heart Association (AHA) and American Stroke Association (ASA) have improved overall survival in the US. \textsuperscript{xx}

The “Implementation Strategies for Emergency Medical Services within Stroke Systems of Care” policy statement outlines specific parameters that measure the quality of an EMS System, including the following:

- The time between the receipt of the call and the dispatch of the response team is <90 seconds.
- EMS response time is <9 minutes (time elapsed from the receipt of the call by the dispatch entity to the arrival on the scene of a properly equipped and staffed ambulance).
- Dispatch time is <1 minute.
- Turnout time (from when a call is received to the unit being en route) is <1 minute.
- The on-scene time is <15 minutes (barring extenuating circumstances).
- Travel time is equivalent to trauma or acute myocardial infarction calls.\textsuperscript{xxi}

“Target Stroke” protocols set the “door-to-needle” time in stroke thrombolysis care at 60 minutes\textsuperscript{xxii}. As is the case for patients with trauma or acute myocardial infarction, prehospital notification of a potential stroke is essential. Several studies have shown that prehospital notification leads to significant reductions in several stroke time benchmarks, including time from arrival to physician assessment, CT performance and interpretation, and is associated with higher rates of intravenous tissue plasminogen activator (t-PA) administration.\textsuperscript{xxiii xxiv xxv}
Status seizures are also considered a life threatening neurological emergency.

Lifesaving prehospital/first responder interventions for neurological emergencies includes the 9-1-1 Emergency Medical Dispatcher (EMD) as the first link in the stroke chain of survival. In one study, EMDs correctly identified 80 percent of all stroke calls if the caller mentioned specific words such as stroke, facial droop, weakness/fall, or communication problems. As detailed in the AHA’s Emergency Cardiovascular Care Committee recommendations for acute stroke, the primary goals of EMS assessment and management are rapid evaluation, early stabilization, neurological evaluation, and rapid transport and triage to a stroke-ready hospital. In status seizures, prehospital administration of a benzodiazepine is a common intervention.

**Trauma**

The trauma “golden hour” accounts for pre-hospital time with an injury to operating room goal. However for traumatic injuries, there are few prehospital interventions that improve survival. The “ABCs” of airway (airway support), breathing and circulation (hemorrhage control-spinal control) and/or fracture immobilization are important, but recognition of potential internal injury and rapid transport to an appropriate receiving facility for definitive care is critical. Faster transport time is, in many cases, lifesaving. This premise is widely researched and accepted in the trauma care community. Authors looking at transport time and outcome studies in trauma have concluded, “The premise that faster transport is better seems justifiable.”

A 2005 study found that helicopter EMS represented the only mechanism by which 27 percent of the U. S. population had timely access (60 minutes or less) to a Level I or II Trauma Center. Air medical transport is also a recognized utility for scene and interfacility transport of trauma patients.

Lifesaving prehospital/first responder interventions in trauma include: Airway support and ventilation; bleeding control; immobilization - all of which may be performed prior to the arrival of ALS care and ambulance transportation.

**When Do Response Times Matter**

It is important to distinguish response time verses rapid transport in understanding the evidence-based research. Rapid transport is a general term implying the recognition of mechanism, illness or injury that requires specialty care intervention at an acute care facility. An ambulance traveling lights and siren with a patient on board is providing rapid transport to that facility for definitive care. Helicopter air ambulance may also be utilized to provide a rapid mode of transport.

Response time (RT) refers to a specific phase of time from emergency call to arrival of a first responder or transporting ambulance. Studies on EMS response times reveal surprising results. Since 2002, three key studies have focused on response times for medical and trauma patients:
Blackwell, et al. attempted to determine the effect of RT on survival to hospital discharge. The study was retrospective, conducted with an urban dataset and included 5,424 patients categorized as priority 1 or 2. The study concluded, “that in the first 5 minutes, survival could be improved if response times were less than 5 minutes, but after 5 minutes the curve flattened. Thus, decreasing response times from 10:59 minutes to 9:59 minutes, 9:59 minutes to 8:59 minutes and so forth down to 5 minutes would not improve the potential for survival”.

In an urban setting study, Pons et al. concluded that “A paramedic response time within 8 minutes was not associated with improved survival to hospital discharge after controlling for several important confounders, including level of illness severity. However, a survival benefit was identified when the response time was within 4 minutes for patients with intermediate or high risk of mortality. Adherence to the 8-minute response time guideline in most patients who access out-of-hospital emergency services is not supported by these results.”

The final study, also conducted by Blackwell, “suggests that when compared with patients who wait less than 10:59 minutes for an ALS response, priority patients who wait longer than 10:59 minutes could experience between a 6% increase to a 4% decrease in mortality. Further, there was no evidence of increased mortality for priority patients where ALS response time exceeded 10:59 minutes.”

This evidence suggests that EMS RT may not be a significant factor in outcomes from acute illness or injury in the prehospital setting.

**Summary**

The goal of EMS system design is to maximize care delivery and resource utilization. Many of the lifesaving interventions require substantial community commitment, such as bystander awareness, education and intervention, for successful outcomes. The scope of practice for emergency medical technicians at the basic and paramedic levels both follow a similar approach, initiating basic life support (BLS) care and then progressing to advanced life support (ALS) as required, understanding that only about 5-10 percent of an urban EMS system’s calls actually require interventions at an ALS level.

Emergency Medical Technicians-Advanced (AEMT) typically have the ability and capability to perform many of the life saving interventions discussed previously i.e. nitroglycerin administered sublingually via a spray or a tablet, albuterol given via an oxygen-powered nebulizer, aspirin orally and epinephrine given as an intramuscular (IM) injection. Similarly, naloxone (which is a reversal agent for opiate overdose) can be given IM or intranasally. Glucagon (which is used to treat hypoglycemia) is given IM. In California CPAP is designated within the EMT scope of care.

The AEMT role is supported by Contra Costa EMS. Department provided documentation demonstrates both a clinical and economic benefit for first responders within the county to adopt this level of care.
Design Attributes - 2014

The attributes of a 2014 evidenced-based EMS system encompasses much more than emergency response and care, it consists of:

- Regional Coordination
- Education & Workforce Supply
- Public Mobilization
- Basic Life Support (BLS) First Response
- Advanced Life Support (ALS) Response and Transport
- Community Paramedicine
- Healthcare Integration
- Needs Assessment & Health Monitoring
- System Finance

Regardless of the initial design, EMS systems must adapt to changes in the healthcare delivery environment. Agility and flexibility are key components in managing change in the future. In managing change, the EMS system must remain vigilant that the patient derives benefit for any and all system revisions.
REGIONAL COORDINATION

The effectiveness of the EMS system depends on the collaboration of multiple agencies. Yet, in actuality, many systems are severely challenged by old, limiting designs, tight resources, turf battles, politics, and rapid changes in the healthcare delivery systems. Coordination and collaboration require commitment to three levels of control: strategic (purpose), tactical (mechanisms), and operational (operations support). Thus a patient-centric design, the underlying purpose for EMS, has no boundaries, shares resources, and seeks to avoid turf battles.

Regional Coordination is founded on legislation and regulation, medical direction, information systems (for research and evaluation) and communications systems. Prevention is also a function of the EMS and a key driver of strategy, tactics and operations. Consider the impact of decades of fire prevention efforts by fire agencies on a national basis. These focused initiatives have driven prevention to the forefront, increased public education and awareness, and led to implementation and enforcement of stringent building codes, which have dramatically reduced the incidence of structure fires. Out-of-hospital and emergency medical care activities delivered by EMS systems can be redirected to accomplish similar results in improving patient outcomes and quality of life. The backdrop for all LEMSA activities is prevention, because a founding principle in illness and injury is “don’t get sick or injured in the first place.” This model for a LEMSA architecture is illustrated in Figure 7.

The EMS Agency takes the lead in strategic control of this attribute but must incorporate the input and involvement of system stakeholders to be successful.

Figure 7. Model LEMSA Architecture
Legislation & Regulation

The California Emergency Medical Services Authority (EMSA or EMS Authority) is charged with providing leadership in developing and implementing Emergency Medical Services (EMS) systems throughout California. Day-to-day EMS system management is a local responsibility. Each county may designate a local EMS agency (LEMSA) which can be the county health department, an agency established and operated by the county, an entity with which the county contracts for the purposes of EMS administration or a joint powers agency. The California Ambulance Association has developed an excellent summary, “Local and State Oversight of Emergency Medical Services in California.”

In Contra Costa County, the Board of Supervisors has designated Contra Costa Health Services as its Local EMS Agency. The EMS Director, EMS Medical Director, and staff carry out the EMS functions of Health Services. The EMS Medical Director has statutory responsibilities to oversee medical aspects of the EMS program.

According to an October 2013 EMSAAC Legislative Report, fourteen new legislative bills relating to EMS are being tracked. Notwithstanding 260 pages of California Code of Regulations Title 22, Division 9, Prehospital Emergency Medical Services and 30 Miscellaneous Statutes Referencing the Emergency Medical Services Authority, tracking, implementing and maintaining State rules and regulations appears a complex and onerous endeavor.

Medical Direction

The American College of Emergency Physicians (ACEP) states:

All aspects of the organization and provision of basic (including first responder) and advanced life support emergency medical services (EMS) require the active involvement and participation of physicians. ACEP also believes that EMS must have an identifiable physician medical director at the local, regional, and state level.

The primary role of the medical director is to ensure quality patient care. Responsibilities include involvement with the ongoing design, operation, evaluation and revision of the EMS system from initial patient access to definitive patient care.

Each EMS system should ensure that the medical director has authority over patient care, authority to limit immediately the patient care activities of those who deviate from established standards or do not meet training standards and the responsibility and authority to develop and implement medical policies and procedures. The EMS medical director’s qualifications, responsibilities, and authority must be delineated in writing within each EMS system. Ideally, the EMS medical director will be a board-certified emergency physician. The EMS system has an obligation to provide the EMS medical
Span of control, or “sphere of authority,” refers to the number of subordinates a supervisor has. In this case of system medical direction, span of control means the number of EMS providers supervised. Significant in light of the role of the subordinate, emergency prehospital care, a system medical director depends heavily on a chain of command, information systems, agency staff and proactive providers to keep him/her informed and enlightened to care provided in the field. There isn’t an evidence-based standard that can be applied to an EMS system medical director’s “span.” Eisenberg (2009) estimates the span of control for King County, Washington, which has a population of two million people and 250 active paramedics in the field: an EMS MD, one full time equivalent, can supervise 125 paramedics. Tulsa, with an estimated population of 400,000, and Oklahoma City, population approximately 600,000, list 2.5 medical director FTE’s each, according to report 2009 from Coalition of Advanced Emergency Medical Systems (CAEMS).

The CCHS EMS Medical Director fills the role as defined by ACEP and as California statutes require. Properly resourced with robust information systems, the function appears adequately staff by one full time equivalent.

**Information Systems**

Technology and information systems have transformed nearly every aspect of healthcare. EMS is no exception. From Enhanced 9-1-1 call location, Computer-Aided Dispatch (CAD), Medical Priority Dispatch to Automatic Vehicle Locating (AVL), electronic patient care records (ePCR) - even field telemedicine, technology and information can enhance all aspects of an EMS system. Few can imagine where the system was a decade ago; let alone what the future holds. Most EMS systems today struggle with linking technologies and creating useful information from massive amounts of raw data. Nowhere is this more evident, exciting, or frustrating, than Contra Costa County.

What’s exciting is that an innovation, borne of a county-based agency and incubated by a grass-roots effort, has now created the greatest improvement in outcomes for cardiac arrest patients. “Enabling Citizen Superheroes,” a smartphone application developed by PulsePoint, is an EMS pre-arrival solution designed to provide response, CPR and defibrillation through bystander notification and citizenship engagement. The adoption and implementation of this smart phone app in the county, partnered with the county Public Access Defibrillation (PAD) Program, and compression-only CPR, has resulted in increased survival from Sudden Cardiac Arrest (SCA).

Alternately, the situation is frustrating because the human element, lack of resources and even in some cases the law, prevent the full realization of technology and information systems to improve prehospital operations, care, and patient outcomes. Examples range from poor data quality (input without quality assurance), data re-entry (voice to voice, verses electronic information exchange) to the inability to
share information between healthcare providers (ePCR incompatibility with healthcare information systems and privacy laws). “The handoff of patients from ambulances to emergency departments (ED) is one of the most critical and information-dependent moments in the healthcare system” according to the State of California Office of Health Information Integrity. Despite implementation of an electronic patient care record for prehospital care providers in Contra Costa County, the ePCR is “printed and delivered by hand or faxed” to the receiving facility in most if not all cases, according to stakeholders.

The Consultant learned from stakeholders that efforts to remedy or improve information systems have had mixed results. Implementation of ZOLL Data Systems ePCR has “unquestionably improved” the quality, collection and reporting of patient care information. Yet FirstWatch’s compliance and oversight software is “incompatible and unstable” in one county PSAP’s computer-aided dispatch platform (New World CAD). Healthcare facilities (HCF) are not monitoring a Hospital Offload Dashboard, designed to reduce offload time and get ambulances back into service. Also, a web-based EMS disaster and healthcare facility communications tool, “ReddiNet” was readily available, visible and mentioned countywide. Unfortunately, live data on ReddiNet was observed to be not hours, but days old, and through further questioning, the Consultant found the tool was not a “go to” for information. According to an August 2013 IBM IS Assessment completed for the EMS Agency,

The EMS Agency staff and management are operating in an environment characterized by multiple information systems and databases. EMS relies to one degree or more on 13 individual information systems. Data from some of these systems (First Watch and ZOLL) are uploaded to a Web site accessible by EMS. Other databases (Trauma One) are e-mailed to EMS. The resulting EMS staff workflows associated with collection, assembly, and use of data is inefficient and labor intensive. This situation makes it increasingly difficult to focus on the primary EMS roles of clinical program development, performance monitoring and evaluation, and public education. Also, because there are multiple instances when a single employee is solely knowledgeable regarding the working of one of these systems, there are multiple single points of failure risk.

The CCC EMS staff has demonstrated resilience and perseverance in tackling these challenges. The staff sought and received a state EMS/HIE demonstration grant to support legwork in identifying these issues and developing solutions, as well as preparing for future software interoperability with HCF information systems (EPIC). A continuity-of-care documentation (CCD) concept, whereby ePCR data could be “push-pulled,” envisions future real-time data exchange for prehospital patients.

For more than a decade an emphasis of emergency response systems is toward interoperability of the radio communications systems. A similar imperative should be directed toward the interoperability and facile communication of information between EMS system participants. The first step is for all first responder and ambulance transport agencies to implement standardized systems for electronic

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1 EMS agencies use FirstWatch to turn raw data into “useful, actionable information to improve operations, performance, clinical measures, and provide early warning for crucial events.” FirstWatch uses automated EMS-centric reporting and real-time, web-based data visualization tools. User-defined data filters called “triggers” help monitor system performance against defined operational objectives.
documentation and dissemination of patient care information. It will be nearly impossible and resource intensive to link various ePCR systems into a common continuous medical record, detailing patient condition and care from the medical dispatch center, first responder agencies, ambulance services, and receiving facilities.

**Communications Systems**

The operational hub of EMS systems is the communications center. Every phase of prehospital emergency response and care requires a functional, robust and disaster-resistant communications system, which must be able to provide:

- Access to the EMS System,
- A determination of the “need,”
- Priority response levels (Medical Priority Dispatch System-MPDS)
- Dispatch and coordination of law enforcement, first responders, fire and transporting ambulances (ground and air),
- Regional coordination of public safety providers,
- Access to medical direction,
- Communication to and between emergency healthcare facilities,
- Public information

Medical triage, through a Medical Priority Dispatch System, sets a prioritization and response plan that sends the right resources, at the right time, for the right patient acuity for system management and risk management. In this way, the communications center, or “dispatch” becomes the tactical component of an EMS system. In a study of the Long Beach, California system published in the Journal of Prehospital and Disaster Medicine in 1992, Stratton, et al., concluded, "Emergency Medical Dispatchers, medically controlled and trained in a nationally recognized dispatcher triage system, were able to provide medical triage to incoming emergency medical 9-1-1 calls with minimal error for under-triage of ALS runs and high selectivity for non-emergency situations."[xlii]

Table 3 below is a commonly used model for response in systems utilizing ALS transport ambulances and BLS/ALS trained fire department first responders. The response units listed in this table are considered a standard, baseline response to the MPDS priority levels.
Table 3 MPDS Response Example

<table>
<thead>
<tr>
<th>MPDS PRIORITY LEVEL</th>
<th>RESPONSE UNITS</th>
<th>MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECHO</td>
<td>AMBULANCE</td>
<td>HOT HOT</td>
</tr>
<tr>
<td>DELTA</td>
<td>AMBULANCE</td>
<td>HOT HOT</td>
</tr>
<tr>
<td>CHARLIE</td>
<td>AMBULANCE</td>
<td>COLD</td>
</tr>
<tr>
<td>BRAVO</td>
<td>FIRE DEPARTMENT AMBULANCE</td>
<td>HOT or COLD COLD</td>
</tr>
<tr>
<td>ALPHA</td>
<td>AMBULANCE or REFERRAL TO ALTERNATE CARE</td>
<td>COLD</td>
</tr>
</tbody>
</table>

It is common for local authorities to create exceptions to the standard baseline responses listed in the table above. These exceptions are selected based on historical, data-based case outcomes.

In addition to the prioritization of system response, the MPDS prioritizes the actions of the dispatcher and bystanders to ensure that life-threatening conditions are identified and responded to immediately. The "first" first responder, the individual(s) having the shortest response time, is the caller who is acting on behalf of the patient. The ability of the EMD to provide life-saving instructions to someone who can provide supportive care is dependent on the identification that a life-threatening condition (i.e., cardiac arrest, choking, respiratory arrest, or emergency childbirth) exists. Coined "Zero-minute" response time to initiate lifesaving support, 9-1-1 call-takers are able to provide appropriate medical instructions to callers over the phone in a fully functional MPDS center.

Emergency 9-1-1 and non-emergency calls within the county are first answered by the law enforcement agency PSAP in the county that has jurisdiction:

- Antioch Police - for the City of Antioch and the City of Brentwood
- Concord Police - for the City of Concord and the City of Clayton
- Martinez Police - for the City of Martinez
- Pleasant Hill Police - for the City of Pleasant Hill
- Walnut Creek Police - for the City of Walnut Creek
- BART Police - for areas within BART Police jurisdiction
- East Bay Regional Parks - for areas within the East Bay Regional Parks District
- Contra Costa County Sheriff - for the City of Lafayette, Town of Moraga, El Sobrante, City of Orinda, City of Pittsburg, and all Unincorporated areas within the area covered by CCRFCC
- Pinole Police – for the City of Pinole, and City of Hercules
- Richmond Police - for the City Richmond and the City of San Pablo
- Wireless 9-1-1 calls are currently answered by the California Highway Patrol Center located in Vallejo; however, some wireless 9-1-1 calls will be answered by the municipal law enforcement agencies above in the near future.

The call is then transferred to the appropriate secondary Public Safety Access Point (PSAP) either the Contra Costa Regional Fire Communications Center (CCRFCC), the San Ramon Valley Fire Protection
District’s dispatch center (SRVF) or the Richmond Communications Center (RCC). Excluding San Ramon Valley and Moraga Orinda, requests for ambulance service in the County are then forwarded to American Medical Response, the area’s contracted ambulance provider, via a CAD-to-CAD interface. This process flow is illustrated in Figure 8.

Figure 8. CCC 9-1-1 Call Workflow

In addition to the Contra Costa County Fire Protection District, CCRFCC user agencies include:
- Crockett-Carquinez Fire Protection District
- East Contra Costa Fire Protection District
- Moraga-Orinda Fire Protection District
- City of Pinole Fire Protection District
- Rodeo-Hercules Fire Protection District

For medical assistance calls, CCRFCC provides standardized Medical Priority Dispatch System protocols that include caller interrogation, determination of appropriate response configurations and modes, and provision of post-dispatch and pre-arrival instructions. Dispatchers are certified as Emergency Medical Dispatchers (EMDs). While utilizing MPDS, and certifying staff as EMDs, CCRFCC has let its International Academies of Emergency Dispatch (IAED) accreditation lapse. Dispatchers work 48 hours on and 96 hours off on a schedule that corresponds to the suppression A, B and C shift schedules. As noted in the 2014 Fitch Con Fire Report this is an uncommon dispatcher shift schedule in the industry. A 2013 EMS industry survey found the most common shift for an Emergency Medical Dispatcher to be 12-hours in length (65 percent). With nearly fifty percent of respondents in that study listed as city/county
governmental third service (23 percent), Fire department, multi-role (25 percent) or Fire department, single-role (one percent), an 8-hour shift was common in 25 percent of agencies and 10-hour shifts in 10 percent. One percent of 244 respondents in the survey reported a 24-hour long EMD shift and none reported shifts extending beyond 24.

The San Ramon Valley Fire Protection District’s 9-1-1-communication center is recognized as an IAED Emergency Medical Dispatch Center of Excellence (ACE). In 1996, the District’s communications center became the eighth center in the world to be awarded this prestigious honor. Accredited status has been continuously maintained since that time, with the most recent reaccreditation being awarded again in 2013.

The Richmond Communications Center (RCC) serves an area covered by several public safety agencies. They include the Richmond Police & Fire Departments, El Cerrito Police & Fire Departments, San Pablo Police, Kensington Police and the Contra Costa Community College District Police. RCC has been previously accredited by IAED but isn’t currently. Line communications personnel are Emergency Medical Dispatcher (EMD) certified and utilize MPDS protocols. It was noted that the RCC operates MPDS via a card (paper) verses electronic system. RCC reports technical interface issues with its CAD, “New World“ and another key electronic reporting platform, “First Watch.”

Recent fiscal challenges in the County have resulted in modifications to the MPDS protocols by the CCCHSD. According to a CCCHSD working document:

In Contra Costa, calls with Echo, Delta, Charlie, and Bravo level determinations are responded to with lights and sirens by both fire and ambulance. Alpha-level calls are responded to without lights or sirens by either an ambulance alone or by an ambulance and fire engine. The Alpha-level response with two resources sent are to patients with falls in which additional resources are often needed to lift the patient. Omega calls are handled as Alpha calls in Contra Costa, as we do not have integration with other resources at this time.

Since the inception of the MPDS system in Contra Costa, there have been a few minor adjustments to its configuration. Based on current configuration, around one in four medical calls receives a response of a single resource, while three of four have both fire and ambulance responses. It is fair to say that the system configuration has not fully utilized the resource-sparing capabilities of MPDS, and that over-response with multiple resources has been common. However, as fire resources have now been reduced in the county and face further reduction, it is an appropriate time to address dispatch issues for medical calls to conserve both fire and ambulance resources. The MPDS system allows this configuration to be done with patient safety in mind.
Specific areas of consideration:

- **Alpha calls**: Currently around 30% of Alpha-level calls receive a two-resource response. This can be limited to a single response, which in some cases would most appropriately be the ambulance, and others in which it may be fire (falls with no injuries in which transport happens with much less frequency). Limiting responses to falls with minor injuries to ambulance only would reduce the fire response in this category by 60%. The overall impact in reduction of fire response would be by approximately 2%.

- **Bravo calls**: Currently both resources are sent lights and sirens to these calls. Depending on the nature of the problem, some are best modified to a lights and sirens response by fire with ambulance responding without lights and sirens. Many of these calls end up being cancelled, and the ambulance resources can be spared in these cases. Other calls can be handled by ambulance response only, and a few may be best handled by fire response only. Initial estimates of possible changes could reduce fire responses by 15% in this category and reduce priority of response in ambulances in around 30%. The overall impact of fire response would be approximately 2% reduction in fire response.

- **Charlie calls**: Many of these conditions do not need timely intervention although they may need timely transport (e.g. stroke). Ambulance-only response can be done in many of these calls (those in whom time-sensitive field interventions are uncommon). Initial estimates are that around 30% of Charlie responses could be handled by ambulance-only responses. The overall impact on fire response would be approximately 6% of all calls.

- **Interfacility transport**: Expanding the use of this category for large medical clinics and nursing homes would reduce the number of responses by fire engines to these areas. The potential reduction estimate is approximately 2% of all calls.

- **Police requests**: Currently some police agencies have a higher-propensity to request EMS responses with lights and sirens, which results in fire response in those cases. Since 7% of medical responses overall involve police requests for lights and sirens response, reduction in this could potentially lead to less fire engine response, although the proportion cannot be estimated. In the long run, non-emergency responses (often for psychiatric patients on 5150 holds) could be reduced by alternative response mechanisms other than paramedic ambulances. This is not a short-term adjustment that can be made in the dispatch system but remains a future consideration.

These proposed modifications demonstrate the impact that a fully functioning MPDS can have on tactical and operational system performance.

“Need” is subject to the prudent layperson definition, and often the easiest solution to a perceived need is to dial “9-1-1.” While not precluding the effect that community healthcare services and education can have on decreasing non-emergency use of a 9-1-1 system, once a call is placed, the need must be addressed. In this way, the communications center becomes a safety net; yet, the best response may not be a full system activation and response. MPDS allows a consistent, benchmarked and safe approach to response. During system design consultations, stakeholders expressed the desire that patients’ needs
be met by the most cost effective and efficient way possible. To that goal, stakeholders suggested communications center enhancements that would direct callers to an appropriate resource, even when that disposition may preclude an EMS response. Emergency care research suggests that this goal is obtainable. In a 2008 study, researchers determined that “a formal EMD system can reduce first-responder call volume by roughly one-half.” Additionally, they found that, “The system appears to be safe for patients, with an under triage rate of about one-half of one percent.”

Contra Costa County medical stakeholders suggested that the full responsibility and potential liability of a “no response” could be shifted to existing “nurse advice” call centers after formal EMD determined a non-life threatening need. Study findings prove the merit of this approach. Studnek, et al. (2011) “identified a method for classifying patients during the dispatch period as low-acuity while attempting to ensure that those individuals received the medical care that they needed” using a MPDS protocol. In a 2013 study published in Prehospital Emergency Care, nearly 20 percent of patients classified as “Omega” (low acuity) by MPDS criteria in a municipal EMS communications center were transferred to a nurse call line. Of those patients who were not transported by ambulance and who completed telephone follow-up, 88 percent reported the non-transport option met their health-care needs and 91.5 percent responded they would accept the (nurse call line) transfer again for a similar complaint. With an annual call volume of 90,000, an average of two patients per day were determined eligible for transfer to the nurse advice line. While impact was limited, there was a decrease in ambulance response. In a 2012 MedStar study, a triage nurse was staffed in the communications center, 9 am to 5 am, Monday through Friday, during a six-month trial to decrease ambulance response to low-acuity calls. Of 401 calls referred to the triage nurse, 150 (37 percent) were ‘alternatively disposed’ to a primary care physician, clinic or self-care with follow up.

Many stakeholder comments about the Contra Costa County radio communications infrastructure were negative. These comments were in contrast with a CCC EMS phased plan to migrate radio systems to the East Bay Regional Communications System (EBRCS). EBRCS is a communications system that will provide fully interoperable communications to all public agencies within Alameda and Contra Costa counties. The system is designed and sized to offer participation to adjoining counties, as well as State and Federal agencies.

**Prevention**

It has been recognized that EMS systems have the infrastructure, competence and capability to fulfill a more important role than solely providing emergency medical response, treatment and transport. Prevention efforts, early identification of symptoms and community education programs have effectively reduced the incidence of some acute emergency medical events. A wide variety of programs have demonstrated positive results, including programs for asthma patients, fall prevention, car seat training, encouraging use of helmets, and early recognition of signs of heart attack or stroke.
CCC EMS Community Outreach (injury prevention, HeartSafe, others) constitutes only three percent of overall department expenditures, according to FY 2012-2013 documentation. Contributing one half of actual CCC EMS acute illness program (trauma, STEMI, stroke and cardiac arrest) funds to prevention, as is common to these programs, would more than triple the funding for outreach efforts.

**Section Recommendations: Regional Coordination**

**Legislation & Regulation**
- Future legislative activity may necessitate additional human (FTE) or information system support for CCC EMS to stay appraised and ahead of new rules and regulations.
- Proactive legislative activity, likely required to enact EMS system design changes, will entail expert support and lobbying activity.

**Information Systems**
- Recommendations contained in the Contra Costa County EMS Agency Assessment of Work Flows and Information Systems Requirements Final Report, August 2013, form a comprehensive, sound basis for future IS architecture. The concepts and design for the IS leverage the data currently gathered and supported in the county into meaningful and easily transferrable patient care information.
- As the recipient of an EMS/HIE demonstration grant, CCC EMS has the opportunity to push ahead information system development to the benefit of patients, providers, healthcare facilities and healthcare payers. The “push” requires expertise and commitment, in time and staff, or outsourced support.
- Adopt and implement a standardized, countywide electronic patient care documentation format and system to facilitate patient care record sharing and compatibility among all healthcare providers.

**Medical Direction**
- Succession planning is key to the CCC EMS Medical Director position. The role demands a look forward and careful planning for a future MD. This transition is best carried out with an eye toward a local or regional successor in an active emergency medicine role.

**Communications Systems**
- Continued education on appropriate 9-1-1-call use, and calls directed to non-emergency community healthcare services.
- Protocols, policies and possible legislation to allow transfer of non-emergency “Omega” calls to formal nurse advice call centers should be developed and implemented.
- The Contra Costa County EMS Medical Director should identify all appropriate community health services and imbed these resources in the MPDS system (Omega Calls).
- As healthcare delivery continues to be re-engineered, dispatch processes must permit the integration, transfer and disposition of patients to alternative care.
- Obtain and retain IAED accreditation in all county PSAP’s. IAED accreditation specifies quality review and assurance of EMD compliance, while providing a national benchmarking standard, both of which can significantly reduce the likelihood of dispatch-related litigation.
- Expedite EBRCS implementation and replacement of radio communications infrastructure.
- The current dispatcher shift schedule in CCCRFCC must be replaced with an 8 to 10- or 12-hour shift. High call volume, over the current shift length, creates a high potential and risk for dispatcher performance degradation and error due to fatigue.

A single, countywide medical communications center, will allow strategic, tactical and operational control within the Medical Director’s full authority. The future center will create efficiency, economy of scale, consistency and single-point application of MPDS. Benefits of consolidating Emergency Medical Dispatch are:
- Improved oversight of all Emergency Medical Services calls within Contra Costa County
- Oversight of contractual performance benchmarks for all Emergency Medical Services calls
- Requirements for maintaining accreditation with the International Academies of Emergency Dispatch
- Ability to generate one patient identifier (incident or run number) to unify all patient records (fire first response, ground/air ambulance, hospital) providing an opportunity for better sharing of patient care records in a Health Information Exchange
- Strengthen disaster medical response, including the management of: Multi-Casualty Incident (MCI) communications, patient transportation communications, and ground/air ambulance resources during a regional disaster
- Center could be utilized as a hub for all ambulance transportation resources within the County (emergency, non-emergency, and interfacility)
- Potential reduced cost to County.

Prevention
- All future prevention activities based in CCC EMS should follow the example of PAD and the HeartSafe Community Models, including current trauma and stroke programs.
- Documentation of CCC EMS Outreach and Prevention activities must capture all time, effort and funds spent on these efforts.
EDUCATION & WORKFORCE SUPPLY

Basic level EMS education is available in a variety of traditional and non-traditional settings. Institutions of higher education sponsor advanced level EMS education, and most courses are available for college credit. Multiple entry options exist for advanced level education, including bridging from other occupations and from basic EMS levels for individuals with no previous medical or EMS experience. All levels of EMS education are available through a variety of distance learning and creative, alternative delivery formats.

Educational quality is ensured through a system of accreditation. This system evaluates programs relative to standards and guidelines developed by the national communities of interest. Entry-level competence is ensured by a combination of curricula standards, national accreditation and national standard testing.

Licensure is based upon the completion of an approved/accredited program and successful completion of the national exam. This enables career mobility and advancement and facilitates reciprocity and recognition for all levels.

Interdisciplinary and bridging programs provide avenues for EMS providers to enhance their credentials or transition to other health career roles and for other healthcare professionals to acquire EMS field provider credentials. They facilitate adaption of the workforce as community healthcare needs, and the role of EMS evolves naturally.

Initial Training and Certification

Three EMS training programs within Contra Costa County offer entry EMT curricula. Admission, length of coursework and graduation rates from these programs was not studied. Initial paramedic level training must be obtained outside the County. An Alameda County EMS website lists educational institutions that offer this training nearby.

Continuing Education

Once licensed, an EMS provider in California must complete required continuing medical education (CME) to recertify. EMTs must obtain at least 24 hours of continuing education hours (CEH) within a two-year certification period. The CEH must be completed through an approved CE provider, in accordance with the California state code provisions contained in Chapter 11 of Title 22, Division 9: Prehospital Emergency Medical Services Regulations. In order to recertify, an Advanced EMT must complete at least 36 hours of CEH within two years from an approved provider. EMT-Paramedic Recertification requires completion of 48 hours of CE pursuant to the provisions of Chapter 11 of the EMS Division.
Contra Costa EMS, in conjunction with other county-based EMS providers, established the Contra Costa
Fire EMS Training Consortium (CCTC) in 2005. The consortium was active up until recent years when
member support dropped off due to lack of individual member agency financial support.

**Advanced EMT**

In looking at those immediate, lifesaving interventions noted in the evidence-based EMS section, the
Advanced EMT fills the needs required as a first responder (http://cchealth.org/ems/pdf/AEMT-Role-
Analysis.pdf). The LEMSA has approved policies and procedures that allow an Advance EMT to:

1. Perform pulmonary ventilation by use of a perilaryngeal airway adjunct.
2. Institute intravenous (IV) catheters, saline locks, needles or other cannulae (IV lines), in
   peripheral veins.
3. Administer the following intravenously:
   a. Glucose solutions;
   b. Isotonic balanced salt solutions (including Ringer's lactate solution);
   c. Intravenous administration of 50 percent dextrose for adult patients, and 10 percent or
      25 percent dextrose for pediatric patients.
4. Obtain venous and/or capillary blood samples for laboratory analysis.
5. Use blood glucose measuring device.
6. Administer, the following drugs in a route other than intravenous:
   a. Sublingual nitroglycerine preparations;
   b. aspirin;
   c. glucagon;
   d. Inhaled beta-2 agonists (bronchodilators);
   e. Activated charcoal;
   f. naloxone;
   g. epinephrine.

**Workforce Supply**

These educational programs supply valuable workforce to the industry, an industry known for high
employee turnover rates. While an assessment of workforce issues and concerns is outside the scope of
this project, the design of an EMS system must consider this element, the human element, because it
serves as the crucial foundation to system sustainability and success. Once a system has established an
adequate workforce, the concept of a “living wage” ensures workforce sustainability. In its most basic
form, a living wage allows an individual or family to purchase the goods and services necessary to
support physical survival, i.e., food, shelter and clothing. A more robust and meaningful definition
includes those items that are considered customary to have at lower income levels in the particular
society, such as transportation, education, healthcare, leisure and financial savings. To further illustrate
this issue, consider a 2013 Living Wage calculation that lists the hourly and annual salary for several
household/family configurations.xlix
Table 4. 2013 Living Wage Calculation for California

<table>
<thead>
<tr>
<th>Family Structure</th>
<th>Living Wage (hourly)</th>
<th>Required income before taxes (annual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Adult</td>
<td>$11.20</td>
<td>$23K</td>
</tr>
<tr>
<td>1 Adult, 1 Child</td>
<td>$22.70</td>
<td>$47K</td>
</tr>
<tr>
<td>1 Adult, 2 Child</td>
<td>$26.33</td>
<td>$55K</td>
</tr>
<tr>
<td>1 Adult, 3 Child</td>
<td>$33.28</td>
<td>$69K</td>
</tr>
<tr>
<td>2 Adults</td>
<td>$16.73</td>
<td>$34K</td>
</tr>
<tr>
<td>2 Adults, 1 Child</td>
<td>$20.80</td>
<td>$43K</td>
</tr>
<tr>
<td>2 Adults, 2 Child</td>
<td>$22.15</td>
<td>$46K</td>
</tr>
<tr>
<td>2 Adults, 3 Child</td>
<td>$27.29</td>
<td>$57K</td>
</tr>
</tbody>
</table>

Three state specific (California) EMS entry-level job salaries are listed from the 2013 JEMS Salary and Workplace Survey in Table 5. Based on this information, the system must anticipate the challenges of the single-wage earner family.

Table 5. JEMS Salary Survey - California

<table>
<thead>
<tr>
<th>2013</th>
<th>EMT Average</th>
<th>EMT-P Average</th>
<th>EM Dispatch Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly (US $)</td>
<td>$17.27</td>
<td>$18.93</td>
<td>$17.04</td>
</tr>
<tr>
<td>Annual (US $)</td>
<td>$35,929</td>
<td>$39,373</td>
<td>$35,438</td>
</tr>
</tbody>
</table>

While LEMSA staff have not identified “living wage” as a current issue within the county, EMS personnel turnover for higher paid bay-area positions is a clear and present risk. The future EMS system must maintain an awareness and strategy for workforce retention that includes prevailing local and regional wage assessment.

**Human Patient Simulation (HPS) Training**

Continuous quality improvement is an accepted mandate and practice in healthcare services. The delivery of the best, evidence-based quality of care ultimately depends on the competencies of practitioners, as well as the system that supports their work. Medical education has been increasingly called upon to ensure providers possess the skills and understanding necessary to fulfill the quality mission. Patient safety has risen to the top of the healthcare policy agenda in the past five years, and has been incorporated into quality initiatives. Demand for curricula in patient safety and the transfer of safety lessons learned in other risky industries have created new responsibilities for medical educators. Simulation-based medical education helps fill these needs. Simulation offers ethical benefits, increased precision and relevance of training and competency assessment, and new methods of teaching error management and safety culture. Additionally, simulation creates an environment for developing teamwork skills.

This program is not required by the County, but is provided by AMR (Meti-Man Simulator) as mobile on-site training of first responder personnel. In the calendar year 2011, 128 training events were provided. Continuous quality improvement in prehospital care is enhanced by this service. Collaboration between
AMR and fire agencies, essential to maintain an optimal team-working environment, is fostered. The use of a single simulator, which is available and used by multiple first responder agencies, results in significant savings and opportunities for the fire agencies and their personnel.

CC LEMSA staff report that the current HPS program suffers from a lack of interest. The program requires a high investment in terms of time and effort. As noted previously, HPS offers real-time skill practice as well as skill and knowledge assessment second only to live patient encounter observations.

**Section Recommendations: Education & Workforce Supply**

**Initial Training and Certification**
- If not already doing so, CCC EMS must monitor initial EMS training admission and completion rates to ensure the system of adequate workforce.
- Future system design should recruit or develop an advanced EMS training facility to provide an in-county AEMT program.

**Continuing Education**
- No recommendations.

**Advanced EMT**
- Champion a transition of paramedic (EMT-P) first responders to the AEMT certification level and scope of practice.

**Workforce Supply**
- Living wage metrics must be assessed annually to assure a continued supply of career-able EMS professionals.

**Human Patient Simulation (HPS) Training**
- HPS is the standard for medical professional skill assessment and hands-on training. In its current design, the emergency ambulance provider and first response agencies gain a “value-added” benefit of teamwork development, above and beyond the training.
- The EMS Medical Director may consider bi-annual or annual skill and knowledge assessment utilizing HPS along with, or supplemented by in field, observation of live patient encounters.
PUBLIC MOBILIZATION

Volunteering is generally considered an altruistic activity and is intended to promote goodness or improve human quality of life. In return, this activity can produce a feeling of self-worth and respect. There is no financial gain involved for the individual. Volunteering is also renowned for skill development, socialization, and fun. It is also intended to make contacts for possible employment. Many volunteers are specifically trained in the areas they work, such as medicine, education, or emergency rescue. Others serve on an as-needed basis, such as in response to a natural disaster.¹

In EMS system design, even “white-board” design, the architects consider, and retain, the highest quality, “best practice” building materials. In one program alone, Public Access Defibrillation (PAD) and the “HeartSafe Community” Project, CCC EMS and Contra Costa citizens, display the best practice. Few programs rise to this level of consideration or commentary unless they possess the right blend of innovation development, implementation and positive outcome – the “wow” factor. As previously referenced in this report, evidence-based research and positive outcomes have shaped the future vision of EMS in Contra Costa. Here, little can be added except to capture the elements of this “best practice,” and to repeat and share the County’s success.

Utstein Criteria established a set of common definitions and spelled out exactly how to report cardiac arrest data.² Contra Costa County participates in the National Cardiac Arrest Registry to Enhance Survival (CARES) developed by the CDC. CARES National data (2012) reported an overall rate of “survival to hospital discharge” of 9.9 percent; Utstein Survival (bystander witnessed, EMS shockable rhythm) at 31.5 percent; and Utstein Bystander Survival (bystander witnessed, bystander CPR and/or AED) at 37.2 percent.³ This same dataset report CCC Survival to Hospital Discharge at 10.8 percent; Utstein Survival at 31.1 percent; and Utstein Bystander Survival at 41.7 percent. San Ramon Valley Fire reports an overall survival rate of 17.9 percent.⁴ While these high survival rates can’t be fully attributed to involvement of the public bystander element, it is undeniable that they can’t be achieved without the public.

Section Recommendations: Public Mobilization

- Borrowing from the PulsePoint Foundation guidelines, it is incumbent on the system stakeholders to acknowledge, embrace and embolden the “Citizen Superhero” concept.
RESPONSE AND TRANSPORT

The EMS attributes, Basic Life Support (BLS) First Response and Advanced Life Support (ALS) Response and Transport, are best considered under a single heading, “response and transport.” There are multiple EMS response and transport models utilized in the industry today:

- Basic Life Support (BLS) transport only
- BLS transport with an Advanced Life Support (ALS) “fly car”
- BLS transport with ALS fire first response
- ALS transport with BLS fire first response
- ALS transport with ALS fire first response
- BLS & ALS transport with BLS fire first response (tiered)

Controversy remains as to which model is the most efficient operational and economical design. Understanding the phases of an emergency response is important to the design of the system. As previously identified, a communication specialist trained in emergency medical dispatch, may be a true first responder by offering emergency care instruction via telephone. The first on-scene responder may be a citizen bystander or volunteer followed by law enforcement or fire personnel. During this first responder phase, airway support, CPR, early defibrillation, and hemorrhage control is critical to the success of an EMS system. Community and school CPR programs, automated external defibrillator (AED) placement, and citizen-bystander activation are low cost, high return leverage points demonstrating improved outcomes especially in Sudden Cardiac Arrest (SCA). This first response provides basic life support, and doesn’t require special skills, knowledge or extensive emergency care experience. Many, if not all, EMS systems are dependent on this type of first response to achieve positive patient outcomes.

A secondary skilled response at the Advanced Life Support (ALS) level begins the next phase of prehospital care. The provision of ALS on a transporting vehicle, allows both a higher level of care and transport of that patient to definitive care. ALS staffing on a transport ambulance creates greater versatility to respond to emergency and non-emergency transports.

**Evidence-based Research – BLS or ALS Response**

Since the 1970s, EMS systems aggressively have been trying to expand ALS coverage with the belief that it greatly improved patient outcomes. In many areas of the country, including California, the expansion of ALS has included first responder agencies. The evidence of ALS benefits is surprisingly contradictory to this belief. An extensive study conducted by the Ontario Prehospital Advanced Life Support (OPALS) Major Trauma Study found no association between paramedic and basic life-support (BLS) care and trauma patient outcomes. The study further concluded, “Evidence indicates that, for patients with suspected head injuries and a Glasgow Coma Scale score of less than nine (9), mortality was greater during the advanced life-support phase of the study than during the basic life-support phase.” The authors suggested that EMS should “carefully evaluate the indications for and application of prehospital advanced life-support measures for patients with major trauma.”
Another study by Adams, et al. titled “Does the level of prehospital care influence the outcome of patients with altered levels of consciousness (ALOC)?,” found that “Advanced life support levels of care of patients with an ALOC does not significantly change outcome compared with those receiving BLS care with the exception of shorter emergency department treatment times for hypoglycemic patients.”

A study by the OPALS group titled “Advanced Cardiac Life Support in Out-of-Hospital Cardiac Arrest” revealed that, “The addition of advanced-life-support interventions did not improve the rate of survival after out-of-hospital cardiac arrest.” The study indicated that rapid defibrillation was the key determinant on patient survival and other ALS interventions did not improve survival rates.

Other studies have suggested the benefits of specific ALS interventions. The OPALS group published the study “Advanced Life Support for Out-of-Hospital Respiratory Distress” which indicated that, “The addition of a specific regime of out-of-hospital advanced-life-support interventions to an existing EMS system that provides basic life support was associated with a decrease in the rate of death. The specific treatment regimen that benefited the patients with respiratory distress could not be delineated because the program to administer nebulized salbutamol and sublingual nitroglycerin was implemented concurrently with ALS interventions.

Medical first response is not required for the majority of 9-1-1 calls. The evidence-based EMS system has systems in place to identify those events that would benefit from the additional resources and early arrival of first responders. By selectively sending first responders only when indicated, the costs to the fire agencies are reduced and the risk inherent to emergency responses is mitigated.

Higher levels of first response may be considered, particularly when response times from the ambulance service are longer, such as in geographic areas of low call density. The Advanced EMT offers an affordable higher level of care and the AEMT’s scope includes the critical ALS interventions to potentially improve patient outcomes.

Most ALS interventions have not demonstrated efficacy, but there is evidence that patients with respiratory distress benefit from ALS. It is also important to acknowledge the role of the ALS providers in the recognition of specific patient acute illness or injury events. ALS caregivers must be able to recognize STEMI, stroke, and trauma patients in order to activate systems and centers to improve patient outcomes.

New ALS interventions will emerge as science provides deeper understandings. Initiating hypothermic procedures for cardiac arrest and acute myocardial infarction is an example of an ALS intervention that was not considered 10 years ago. It is likely, that other ALS interventions and pharmacological agents will be added to the ALS caregivers’ repertoire as research continues.
**ALS Providers**

In 2003, Fitch & Associates was contracted by Contra Costa County to provide recommendations on revisions to the County’s EMS system. At that time, the focus of EMS system improvements was on the expansion of Advanced Life Support (ALS) and shortening the time patients would receive ALS care. Specifically, provisions for improving the Contra Costa County EMS system were, as described in the Fitch report, “developed to allow fire agencies to increase their role in EMS primary ALS first response with flexibility to gradually implement a countywide system.” The question left unanswered at this time was, are more ALS providers better? Many EMS systems are now asking “is more better?” The short answer, adding ALS personnel to a prehospital incident, is rarely based on patient medical need. Out-of-hospital cardiac arrest (OHCA) is where ALS care is generally associated with positive outcomes. In a study of ambulance crew configuration on simulated cardiac arrest resuscitation Bayley et.al. concluded that, “Two paramedic crews were more error-prone and did not perform most interventions more rapidly with the exception of intubation. These data do not support the proposition that two paramedic crews provide higher quality cardiac care than paramedic-EMT crews in a simulated ventricular fibrillation arrest.” Additionally, a larger, patient based, retrospective database review, using Utstein-style reporting definitions in OHCA, was conducted in Milwaukee County, Wisconsin. Results from this review noted, “return of spontaneous circulation was not influenced by the number of paramedics present.”

**Dispatch and Response Data Analysis**

**Introduction**

Peer-reviewed medical evidence literature on response time was presented earlier in this report. The determination of current activity and performance levels for the EMS system is essential in order to identify opportunities for enhancement and modernization of the system and its processes for involved agencies.

In this study, the Consultant undertook a number of complex analyses to understand what is occurring in the County and to provide a body of information on which to base recommendations for change, in keeping with the goals of the project.

Specifically, the data analysis processes were designed to

- quantify activity levels of the system participants,
- measure time intervals for the incremental components of an emergency response and transport, and
- delineate the distribution of EMS calls on a geographic and temporal basis.

The results of the data analyses are designed to allow the Consultant’s team to develop and propose relevant recommendations to

- improve the current processes and practices,
- develop a baseline of activity and trends to forecast resource requirements, and
- create system design changes based on the system’s infrastructure, demand, and data relationships.

**Overview of Data Analyses**

Typical EMS systems use a 26-week period for the data collection and analysis. While, it is unlikely that there would be significant statistical changes in the results, the EMS study used a full year’s data from the five organizations utilizing CAD systems. The dates used in the analyses for each of the agencies are listed in Table 6.

**Table 6. Time Intervals Analyzed**

<table>
<thead>
<tr>
<th>Agency Name</th>
<th>Time Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Medical Response</td>
<td>07/01/2012 – 06/30/2013</td>
</tr>
<tr>
<td>Contra Costa County Fire Protection District</td>
<td>07/01/2012 – 06/30/2013</td>
</tr>
<tr>
<td>Moraga-Orinda Fire District</td>
<td>07/01/2012 – 06/30/2013</td>
</tr>
<tr>
<td>Richmond Fire Department</td>
<td>10/01/2012 – 09/30/2013</td>
</tr>
<tr>
<td>San Ramon Valley Fire Protection District</td>
<td>07/01/2012 – 06/30/2013</td>
</tr>
</tbody>
</table>

Agencies were assigned acronyms for use in the data analyses. These acronyms will also be used in this section of the report and the related appendices. The acronyms are listed in Table 7.

**Table 7. Acronyms Representing Names of Agencies**

<table>
<thead>
<tr>
<th>Agency Name</th>
<th>Acronym</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Medical Response</td>
<td>AMR</td>
</tr>
<tr>
<td>Contra Costa County Fire Protection District</td>
<td>CON</td>
</tr>
<tr>
<td>Moraga-Orinda Fire District</td>
<td>MOR</td>
</tr>
<tr>
<td>Richmond Fire Department</td>
<td>RMD</td>
</tr>
<tr>
<td>San Ramon Valley Fire Protection District</td>
<td>SRV</td>
</tr>
</tbody>
</table>

For ease of analysis, other acronyms, abbreviations, and shorthand descriptions were used in the analyses and included in this report. Table 8 provides a description of these.

**Table 8. Acronyms, abbreviations and pseudonyms**

<table>
<thead>
<tr>
<th>Description</th>
<th>Acronym/Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical First Response</td>
<td>MFR</td>
</tr>
<tr>
<td>Arrived at Scene</td>
<td>ArvAtScene</td>
</tr>
<tr>
<td>90%-tile</td>
<td>90th percentile</td>
</tr>
<tr>
<td>Priority 1</td>
<td>P1</td>
</tr>
</tbody>
</table>

The agencies’ activities included in the data analyses include those providing medical dispatch, patient transportation and medical first response. Categorizations of the agencies’ functions are summarized in Table 9.
Table 9. Providers of EMS Dispatch, Medical First Response and Transport Services for Each Agency

<table>
<thead>
<tr>
<th>Agency</th>
<th>Dispatch</th>
<th>Medical First Response</th>
<th>Patient Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMR</td>
<td>AMR Dispatch</td>
<td></td>
<td>AMR</td>
</tr>
<tr>
<td>CON</td>
<td>CON Dispatch</td>
<td>CON</td>
<td>AMR</td>
</tr>
<tr>
<td>MOR</td>
<td>CON Dispatch</td>
<td>MOR</td>
<td>MOR</td>
</tr>
<tr>
<td>RMD</td>
<td>RMD Police Dispatch</td>
<td>RMD</td>
<td>AMR</td>
</tr>
<tr>
<td>SRV</td>
<td>SRV Dispatch</td>
<td>SRV</td>
<td>SRV</td>
</tr>
</tbody>
</table>

The amount of data collected from the EMS system is enormous. The key step is to define the metrics to be measured. The metrics defined for this project were required to be relevant to understanding the activities and performance of the current system and valuable in identifying opportunities for improvement in efficiency, effectiveness, or economy.

Table 10 describes the metrics used for analysis of call processes and performance for each of the agencies.
Table 10 Performance Metrics of the EMS Providers in Contra Costa County

<table>
<thead>
<tr>
<th>Performance Metrics</th>
<th>CON</th>
<th>MOR</th>
<th>RMD</th>
<th>SRV</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMS Incidents With Units(s) Arrvd AtScene Per Calendar Intervals</td>
<td>36,570</td>
<td>2,099</td>
<td>8,509</td>
<td>6,072</td>
</tr>
<tr>
<td>Dispatch-Time of MFR Unit [min:sec] @ 90%-tile</td>
<td>01:39</td>
<td>01:46</td>
<td>03:41</td>
<td>00:42</td>
</tr>
<tr>
<td>Interval to Notification of Transport Agency [min:sec] Average</td>
<td>01:22</td>
<td>00:22</td>
<td>-02:46</td>
<td>-00:03</td>
</tr>
<tr>
<td>MFR Response Time [min:sec] @ 90%-tile</td>
<td>09:57</td>
<td>08:58</td>
<td>11:02</td>
<td>07:29</td>
</tr>
<tr>
<td>Transport Unit Response Time [min:sec] @ 90%-tile</td>
<td>11:05</td>
<td>12:07</td>
<td>09:22</td>
<td>09:18</td>
</tr>
<tr>
<td>MFR Unit First AtScene [%]</td>
<td>66.6%</td>
<td>98.7%</td>
<td>69.6%</td>
<td>73.1%</td>
</tr>
<tr>
<td>Time-on-Task, Transport Unit [min:sec] average</td>
<td>55:17</td>
<td>50:34</td>
<td>50:25</td>
<td>52:01</td>
</tr>
</tbody>
</table>


Data in Table 10 is for the interval Jan – Jun 2013 only. Fitch believes this data best represents the current performance of SRV.

3 Time interval from when a call rings-into CON to when a MFR unit is assigned for P1 Priorities at 90%-tile

4 Time interval from when a call rings-into CON to when a MOR MFR unit is assigned for P1 Priorities at 90%-tile.

5 Time interval from when a call rings-at CON to when a MFR unit is assigned. Calculated for Priority 1 MEDIC Codes at 90%-tile

6 Time interval from when a call rings-in to SRV to when a MFR unit is assigned for Medical - Echo / Delta Codes at 90%-tile.

7 Determined in the AMR database as the interval from when the incident rang-into CON and when the CON notification rang into AMR. Calculated as an average.

8 Determined in the CON CAD as the interval from when the incident is assigned to a MOR MFR unit and when the incident is assigned to a MOR transport unit. Calculated as an average.

9 Determined in the RMD database as the interval from when the incident rang-into RMD and when the RMD notification rang into AMR. Calculated as an average.

10 Determined in the SRV database as the interval from when the incident is assigned to an SRV MFR unit and when then incident is assigned to a transport unit. On average he SRV transport unit is notified three seconds before the MFR unit.

11 Response time is interval from when a call rings-in to CON to when the MFR unit arrives on scene, as determined from AVL timestamps for P1 priorities at 90%-tile.

12 Response time is interval from when a call rings-in to CON to when the MOR MFR unit arrives on scene, as determined from AVL timestamps for P1 Priorities at 90%-tile.

13 The interval from when a call rings-in to RMD to when the RMD MFR unit arrives on scene, as determined from CAD timestamps for Priority 1 MEDIC Codes at 90%-tile.

14 Response time is interval from when a call rings-in to SRV to when the SRV MFR unit arrives on scene, as determined from CAD timestamps for Medical - Echo / Delta Codes at 90%-tile.

15 Time interval determined in the AMR CAD from when a unit is assigned to when the unit arrives at scene. Calculated for A1 priorities at 90%-tile

16 Response time is interval from when a call rings-in to CON to when the MOR transport unit arrives on scene as determined from AVL timestamps for P1 Priorities at 90%-tile.

17 Time interval in the AMR CAD from when a unit is assigned to when the unit arrives at scene for A1 priorities at 90%-tile.

18 Timestamps for arrived at scene exist for both the CON unit and the AMR unit. The percentage represents the portion of MFR arrivals one second sooner than the AMR arrival.

19 Timestamps for arrived at scene exist for both the MOR MFR unit and the MOR transport unit. The percentage represents the portion of MFR arrivals one second sooner than the transport arrival.

20 Timestamps for arrived at scene exist for both the RMD MFR unit and the AMR unit. The percentage represents the portion of MFR arrivals one second sooner than the AMR arrival.

21 Timestamps for arrived at scene exist for both the SRV MFR unit and the SRV transport unit. The percentage represents the portion of MFR arrivals one second sooner than the AMR arrival.

22 Interval from when a CON unit assigned to when call clears as determined from AVL timestamps for P1 Priorities at 90%-tile.

23 Interval in the CON CAD from when a MOR MFR unit is assigned to when call clears, as determined from AVL timestamps for P1 Priorities at 90%-tile.

24 Interval from when a RMD unit is assigned to when call clears, as determined from CAD timestamps for Priority 1 MEDIC Codes at 90%-tile.

25 Interval from when a SRV unit is assigned to when call clears, as determined from CAD timestamps for Medical - Echo / Delta Codes at 90%-tile.

26 Interval in AMR database from when AMR unit is assigned to call cleared for A1 priorities at 90%-tile.
The data used in this analysis were derived from a number of sources. In order to create valid and comparable results, the data were compiled into a single data base for examination. The detailed processes used in the analysis and how some of the challenges were addressed are described in Appendix 1.

**Findings of Data Analysis for Dispatch and Response**

More than two-thirds of the medical incidents included in the analysis were dispatched by Contra Costa fire for first response by units from ConFire, East Contra Costa Fire, Pinole, and Crockett, etc. The remainder was responded to by Moraga Orinda, SRVFPD, and Richmond first responders.

AMR is the transporting agency for the calls originating in the ConFire and Richmond response areas. Moraga Orinda and San Ramon Valley provide the transport capability for their service areas.

Dispatch intervals and the resulting response times vary, based on the dispatching entity.

San Ramon Valley dispatch processes result in high levels of performance. The interval from the time the call rings in dispatch to the dispatch of the first responder unit and transport unit is within 40 seconds, 90 percent of the time. San Ramon Valley’s dispatch operational performance exceeds NFPA standards and all industry defined best practices.

Richmond consumes 3 minutes and 40 seconds at the 90th percentile to dispatch its first responders and it takes an average of 2 minutes and 46 seconds from the call ringing in dispatch until the call is transferred to AMR. These extended dispatch times exceed all standards and best practice efforts.

ConFire dispatches for its medical first response units and for Moraga Orinda units. The dispatch time from the time that the call rings until the medical first responder is notified is 1:39 for ConFire and 1:46 for Moraga Orinda at the 90th percentile.

The interval for notification of the transport unit is recorded with two different calculations. The notification of AMR from Richmond and ConFire is calculated from the time that the call rings in dispatch until AMR is notified. On average, it takes ConFire 1:22 to notify AMR for a response and it takes Richmond 2:46. Both of these intervals exceed best practice goals of 60 seconds 90 percent of the time.

---

27 Interval in the ConFire CAD from when a MOR transport unit is assigned to when call clears, as determined from AVL timestamps for P1 Priorities at 90%-tile.
28 Interval in AMR database from when AMR unit is assigned to call cleared for A1 priorities at 90%-tile.
29 Interval in the SRV database from when SRV transport unit is assigned to call cleared for Medical - Echo / Delta Codes at 90%-tile.
The interval to notification of the transport unit for Moraga Orinda and for San Ramon Valley is the time elapsed between the notification of the first responder unit until the transporting unit is notified. On average, the Moraga Orinda transporting unit is notified 22 seconds after the first responder is notified. San Ramon Valley notifies its transporting unit simultaneously with its first responders and on average the database indicates that the transporting unit is notified 3 seconds prior to the first responder.

Table 11. AMR Chute and Drive Times From CAD and AVL Timestamps on A1 Priority Incidents.

<table>
<thead>
<tr>
<th></th>
<th>Chute-Time [min:sec] @ 90%-tile</th>
<th>Drive-Time [min:sec] @ 90%-tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>From CAD Timestamps</td>
<td>01:34</td>
<td>09:49</td>
</tr>
<tr>
<td>From AVL Timestamps</td>
<td>01:19</td>
<td>10:12</td>
</tr>
</tbody>
</table>

In reviewing the data, some anomalies are revealed. For example, quantifying the Chute Time intervals from timestamps generated from pressing the mobile data terminal button differ from those calculated using AVL data. Similarly, the drive times differ by an equivalent amount. This is demonstrated in Table 11.

San Ramon Valley has made significant improvements in its dispatch and response performance for the various periods reviewed from the data bases. Table 12 below show the metrics reviewed and the performance improvements. For this reason, the 2013 data was used in the analysis since it most accurately reflects current performance. At the 90th percentile, Dispatch Times have shortened by 22 seconds, first responder times by 36 seconds, and transport unit response times by 58 seconds. Performance by San Ramon may be attributed to the immediate dispatch of response units prior to call categorization and caller interrogation.

Table 12. Improving Performance of the San Ramon Valley Fire District for Medical – Echo/Delta Codes

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatch Time @ 90%-tile</td>
<td>01:04</td>
<td>00:48</td>
<td>00:42</td>
</tr>
<tr>
<td>MFR Response Time @ 90%-tile</td>
<td>08:05</td>
<td>07:59</td>
<td>07:29</td>
</tr>
<tr>
<td>Transport Response Time @ 90%-tile</td>
<td>10:16</td>
<td>10:06</td>
<td>09:18</td>
</tr>
<tr>
<td>MFR Time-on-Task average</td>
<td>22:04</td>
<td>21:39</td>
<td>21:34</td>
</tr>
<tr>
<td>Transport Time-on-Task average</td>
<td>51:25</td>
<td>50:25</td>
<td>52:01</td>
</tr>
</tbody>
</table>
Transport Statistics

The three agencies transporting emergency medical patients within Contra Costa County perform similarly, based on the performance or requirements or goals established within their service areas. The statistics for various metrics for the transporting agencies are included in Table 13.

The statistics reveal pertinent findings. For example, when AMR is responding to priority 1 calls in the ConFire service area its response time is 11:05, 90 percent of the time, which is consistent with its contractual requirements of 11:45 / 90 percent. AMR's response time performance in Richmond is 9:18, 90 percent of the time. This indicates that AMR is substantially in compliance with its contractual obligations.

At the 90th percentile, Moraga Orinda's transporting unit responds within 12:07 and San Ramon’s ambulance responds within 09:18. These performance levels are appropriate and indicate a consistently responsive ambulance service.

Table 13. Transport Statistics

<table>
<thead>
<tr>
<th>Performance Metrics</th>
<th>AMR for CON 30</th>
<th>MOR 31</th>
<th>AMR for RMD 32</th>
<th>SRV 33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Time, Transport Unit [min:sec] @ 90%-tile</td>
<td>11:05</td>
<td>12:07</td>
<td>09:19</td>
<td>09:18</td>
</tr>
<tr>
<td>AtScene-Time [min:sec] average</td>
<td>14:56</td>
<td>11:59</td>
<td>14:17</td>
<td>14:27</td>
</tr>
<tr>
<td>Time-on-Task [min:sec] average</td>
<td>55:17</td>
<td>50:34</td>
<td>50:22</td>
<td>52:01</td>
</tr>
<tr>
<td>Transports per Transport Unit Response</td>
<td>71.2%</td>
<td>72.6%</td>
<td>81.5%</td>
<td>72.8%</td>
</tr>
</tbody>
</table>

There are other important findings in the analysis of the transporting services. Moraga Orinda has a significantly longer transport time than the other two services, which is reflective of longer distances to the appropriate receiving hospitals.

Two other significant findings are revealed. AMR has a protracted time to transfer patient care at the hospitals. It takes, on average, 33 minutes from arrival at the hospital until the unit is back in service while for Moraga Orinda and San Ramon these interval are 18 and 25 minutes, respectively. The

30 All time intervals are for A1 Priority Codes. The percentage transports is for A1 & A3 Priority Codes.
31 All time intervals are for P1 Priority Codes. The percentage transports is for all Priority Codes.
32 All time intervals are for A1 Priority Codes. The percentage transports is for A1 & A3 Priority Codes.
33 All time intervals are for MEDICAL - ECHO/DELTA Priority Codes. The percentage transports is for all Priority Codes.
remaining salient finding is that more than 81 percent of the emergency responses within Richmond result in transport, while the remaining County’s patients are transported at the more common 72 percent level.

**Deficiency of Analysis**

The Consultant’s analysis of ConFire services showed the proportion that auto-aid and mutual aid represent of total activity in the system. Around one-fifth of all EMS activity in the system may fall into this category. The auto aid calls between medical first responders and mutual aid calls between transporting agencies were not isolated for further analysis and were not included in the assessment. These should be studied separately to determine if major holes exist in system coverage, and whether a portion of the County residents is receiving poorer performance from their EMS system.

Currently, there are four CADs in the County. During these analyses, the Consultant made extensive efforts to track standard incidents as they were transferred between agencies.

Contra Costa County needs to adopt a KEY_ID field across all four CADs such that actions logged into one CAD for an incident could be unambiguously tracked to actions logged into a second CAD for the same incident.

There is an alternative to a countywide KEY_ID field. Each CAD already has its own unique KEY_ID field. Reciprocally transferring and logging each agency’s field would result in higher efficiency.

The assumption is that latitudes and longitudes of incidents would serve as KEY_ID fields. This approach is confounded because the various CADs use different correspondence tables between street addresses and latitudes and longitudes. The next naïve assumption is that the street addresses would accurately serve as KEY_ID fields. This approach is also confounded because each CAD uses different formats for logging street addresses. It becomes nearly impossible to rely on exact matches of text strings to determine correspondences.

**Transport**

Medical transportation service is defined by the level of care required, or provided, during transport. Critical Care Transport (CCT) is the highest level of out-of-hospital care available to critically ill patients at an accident scenes or a facility where the patients' needs exceed available resources. The care provided may include advanced medical, surgical and pharmacological interventions. CCT is common in today’s healthcare services environment—an environment that emphasizes regionalized ‘tertiary,’ or specialty hospitals. Interfacility high-risk obstetrics and neonatal and pediatric transport services are often components of critical care transport systems. CCT is typically staffed with a critical care registered nurse (RN) partnered with an emergency medical technician paramedic (EMT-P). Some CCT programs staff with physicians (MD) but this level of staffing and care is provided by less than one percent of US-based CCT programs. This level of care may be provided in an air (helicopter or fixed wing) ambulance.
Advanced Life Support (ALS) services are provided at the EMT-Paramedic level of care and involve the provision of advanced airway control, selected pharmacologic interventions, and select invasive procedures as well as cardiac monitoring and defibrillation.

Basic Life Support (BLS) services are defined as the level of care that can be provided by an Emergency Medical Technician Basic (EMT-B). BLS services are limited to a basic level of patient intervention to include oxygen administration, splinting, bandaging, CPR, airway control, etc. Few (if any) pharmacological agents are allowed. Automated External Defibrillation (AED) may be provided at the EMT-B level, cardiac monitoring and advanced cardiac interventions are not. BLS transport may also be offered in instances where a patient is bedridden and can’t be transported by wheelchair in an ambulette.

Ambulette or wheelchair transports are provided to non-ambulatory, wheelchair patients often needing little medical care short of maintaining oxygen administration. These transports are staffed by a single attendant, either an EMT or first aid-level driver without any provision of care during transport.

### Non-Emergency and Interfacility Ambulance Transport

There are approximately a dozen non-emergency ambulance service providers operating within Contra Costa County. These services provide ambulance transportation between medical facilities; for patients being discharged from facilities; repetitive transports (for dialysis, radiation treatment, wound care, etc.); and for other patients needing non-emergent ambulance transport.

It is estimated that there are more than 50,000\(^{34}\) interfacility (IFT) and non-emergency transports completed annually within the County. This number is expected to grow rapidly with the changing healthcare environment. Healthcare systems are consolidating many of their specialized services in order to achieve higher quality while controlling costs. This results in the movement of patients among the healthcare system’s facilities. Many of these events may be urgent in nature.

IFT and non-emergency transport are provided at the BLS, ALS, and CCT levels of capability. Ambulance providers often contract with healthcare facilities or systems to provide these services in the County. Requests for these interfacility transports are not captured by the LEMSA or PSAP’s as they are typically directly telephoned to a transport provider. Because they are not routed through a PSAP, the calls may not be medically screened using MPDS standards and are not documented for CC EMS Medical Director quality review and oversight. During interviews with the Consultant, hospital representatives expressed concerns for the wide variability of quality and responsiveness among these providers.

CCT, provided by air ambulance or out-of-county ground CCT specialty units, is adequate according to system healthcare providers. Interviews with healthcare facility representatives indicated that there

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\(^{34}\) CCC EMS Survey, 2011
were challenges within the County on accessing appropriate level (ALS) interfacility services. The medical conditions of many patients being transferred from one hospital to another to obtain higher levels of care require the skills or capabilities of personnel beyond that of an EMT-B. The facility representatives indicated that they frequently have to wait a considerable period of time for CCT services, when interfacility ALS care would suffice.

The distinction between EMS, IFT, and non-emergency ambulance transportation is no longer distinct. The acuity levels of patients being transported are often high and the need for timely response and transport is similar to that experienced by EMS.

With the potential for alternative destinations, treat and release, and referral of patients within the EMS system of the future, it is anticipated that the EOA EMS providers will expand their roles into these types of ambulance transports.

When EMS Agencies were first established in California, their focus was primarily on emergency response and ALS. This attention to EMS over the decades has allowed the non-emergency and IFT ambulance services to often operate without adequate oversight. Little is done by the EMS Agency to ensure adequate quality and performance of these providers. This has resulted in wide variability in levels and quality of care and performance. Ambulance patients, regardless of whether they are being transported as a result of a 911 call, a request from a hospital to transfer them to another facility, or are being discharged home; should expect and receive appropriate and quality services. This cannot be guaranteed in Contra Costa County.

CCC EMS has recognized this weakness and is preparing a county ordinance to include specific performance and quality requirements and IFT, non-emergency, and CCT transport agencies. The combination of these requirements, permitting processes, inspections, and on-going monitoring will ensure that all ambulance patients receive appropriate care. The permit and inspection fees should be established to fund the oversight and permitting responsibilities of the agency.

**No-Transport**

Beyond the discussion of response and transport, new models of pre-hospital care are designed to avoid, when appropriate, transport of patients to acute care facilities when prehospital care with no transport, community care, or an alternative care setting is better suited to the patient’s need. However, under current statutory guidance for the reimbursement policies of the Centers for Medicare and Medicaid Services (CMS), policies that are generally followed by private insurance plans, EMS units are strongly incentivized to transport 9-1-1 callers to a hospital ED to receive reimbursement. In a 2013 study, Alpert et al. estimated “that 12.9–16.2 percent of Medicare covered 9-1-1 emergency medical services (EMS) transports involved conditions that were probably non emergent or primary care treatable.” The report concluded, “If Medicare had the flexibility to reimburse EMS for managing selected 9-1-1 calls in ways other than transport to an ED, we estimate that the federal government
could save $283–$560 million or more per year, while improving the continuity of patient care. If private insurance companies followed suit, overall societal savings could be twice as large.
lxiii

“Treat and release” was an idea voiced consistently to the Consultant. Research on the topic revealed no statutory authority allowing this treatment option. Other stakeholder ideas suggested a “schedule and release” process whereby prehospital personnel could arrange an urgent or primary care option for a patient and release that patient on-scene. Variations on the no transport theme included “hear and release,” employing EMD without activating a response, also “see and release,” a pre-hospital version of telemedicine.

**Calls for “5150”**

Section 5150 is a section of the California Welfare and Institutions Code (specifically, the Lanterman–Petris–Short Act or “LPS”) which allows a qualified officer or clinician to involuntarily confine a person deemed to have a mental disorder that makes him or her a danger to self, a danger to others, and/or gravely disabled. A qualified officer, which includes any California peace officer, as well as any specifically designated county clinician, can request the confinement after signing a written declaration.lxiv This issue, referred to as “Fifty-One Fifty” received more stakeholder commentary than most design comments in the entire consultation process. The Contra Costa Medical Director prepared a position statement on this issue that identifies

- increasing incidence of behavioral-psych patients over the past several years, felt to be a combination of limited access to mental health services, as well as an increased propensity for police agencies to place psychiatric holds on patients,
- “time on task” duration, which for these patients, is longer than almost all other categories,”
- a generally longer response time,
- a longer transport distance,
- a longer offload time,
- a difficult situation for fire agencies because they travel long distances to CCRMC and the offload delays keep them out of their jurisdictions for long periods of time,
- paramedic resources are overkill for many mental health patients,
- personnel safety issues because a single provider rides in the back of the ambulance alone with the patient - law enforcement personnel rarely assist in the transport.

In summary, transport of 5150 patients represents a significant proportion of EMS transports, and the high volume use of this specialty center has impacts on EMS deployment throughout the County.

**Phillip Dorn Respite Center for the Homeless**

Calls to, and transports out of the Phillip Dorn Respite Center for the Homeless located in this area have doubled over the previous five years to nearly 250 calls annually. Similar in result to 5150 issues, the call volume, for typically low-acuity problems, creates a cascade of challenges in the system.
Section Recommendations: Response and Transport

Evidence-based Research – BLS or ALS Response
- Evidence does not support the need for ALS first response, and the focus of EMS should be on expanding first responder resources at the Advanced EMT, as well as citizen bystanders.
- In addition to fire departments, the EMS system should consider adding medical first responders, particularly in areas where fire responders are not closely located. This may include consideration of providing law enforcement agencies with training and AEDs in poorly covered areas or enlisting other community volunteers to respond to selected medical emergencies.
- Medical first response is not required for the majority of 9-1-1 calls. Medical Director leadership for MPDS modifications must be made in realization of this evidence.
- The system should not set a requirement for the number of ALS responders, only ensure ALS capability in the system.

Dispatch and Response
- Dispatch of first responders and the transporting ambulance must be improved to the best practice 60 seconds 90 percent interval across all county secondary PSAPs.
- The response time goal for BLS and defibrillation first response to potential cardiac arrest patients should be less than ten minutes, 90 percent of the time.
- The system response time goal for ALS response and transport should be established between 12 and 13 minutes, 90 percent of the time.

Transport
- Interfacility ALS level transport services are needed within the county. Pre-work on this program has been completed by LEMSA staff.

Non-Emergency and Interfacility Ambulance Transport
- Telephone, non-PSAP routed call requests must be captured and documented in an MPDS system, available to the CC EMS MD. A consolidated county communications center could serve as the interfacility transport “hub.”
- Enact county ordinance for IFT, non-emergency BLS and ALS ambulance transport providers.
- Develop and implement policies, procedures and requirements for the IFT, non-emergency, and CCT providers to maintain compliance.
- Establish appropriate oversight activities within CCC EMS to monitor activities and ensure appropriate medical transportation services are provided.

No Transport
- 9-1-1 nurse triage “hear and release” may be possible under the current state EMS rules. A trial study, in partnership with healthcare system partners (with subject matter expertise), must be on the horizon for the future EMS system.
“Treat and no transport,” as well as “schedule and release” require legislative changes, reimbursement realignment and healthcare system buy-in. Within the county-operated providers and payers, an incubator exists – vision, leadership, and persistence are all that are required.

Calls for “5150”

- This situation calls for a collaborative “summit” meeting with law enforcement, EMS, transport providers and mental health officials to solve the issue and develop immediate short and medium term solutions to a mission-critical and patient-centric problem.
- Future system design in the County and EMS must include the provision of prehospital, mobile behavioral and mental health professionals.
- Behavioral health telemedicine and call center coordination of 5150 patient disposition has demonstrated a positive impact on prehospital and emergency department workflow, time on task, while improving care for the patient.
- While there is no solution to the impact of mental health issues on emergency and healthcare providers, strategies and programs should be developed to mitigate the current resource-intensive actions used to deal with this healthcare problem.

Phillip Dorn Respite Center for the Homeless

- MedStar, a Dallas – Fort Worth EMS provider has implemented an "EMS Loyalty" Program - Patients who use 9-1-1 fifteen or more times in 90 days are enrolled. Mobile Health Providers (MHPs) conduct regular home visits, connect the patients to available resources and teach the patients how to better manage their own healthcare. In the short term, regularly scheduled visits to this locale by County community healthcare staff should alleviate over-utilization of EMS resources by this address.
- Considerations for the future EMS system could include scheduled and supervised EMS student clinical practicums at this type of shelter, utilization of a health aide, and provision of homeless first aid instruction with donated provisions of first aid kits.
- This issue is likely to occur, or does occur, at other sites. CCC EMS may consider a tabletop “disaster drill” of sorts, involving multiple stakeholders, to problem solve and develop solutions to issues like this and “5150.” The goal of this drill is to derive immediate solutions and implementation plans to prevent a long-term system impact.
COMMUNITY PARAMEDICINE

In EMS systems across the County, emergency department first responders spend a disproportionate amount of time and money providing non-emergent care to patients whom could be better served in a community setting. The previous section of this report has clearly identified that case in Contra Costa County. Community paramedicine (CP) is a new and evolving model of prehospital care in which EMS personnel function outside an emergency role to provide and enhance primary care in the community. According to a 2013 report from the Institute for Population Health Improvement at UC Davis, CP programs “may lead to more optimal use of EMS assets and offer some potential for diversification of the EMS funding base.” In this report the authors state CP programs may result in, “More appropriate use of emergency care services, increased access to primary care for underserved populations and enhance opportunities for EMS personnel.” Community Paramedics extend the primary care physician’s reach by providing service within their scope directly to patients in their homes. The care is prescribed by the physician and the visits offer the opportunity for the paramedics to assess the patient and his or her environment, refer the patient to other social agencies, conduct home safety checks, and offer alternatives to frequent use of 9-1-1 services. The implementation of community EMS is occurring in a few locations throughout the U.S. Two such programs are in their initial stages of implementation, Western Eagle County Health District in Colorado and MedStar 9-1-1 of Fort Worth Texas.

Western Eagle County Health District in Colorado has established a Community Paramedic program, “To improve health outcomes among medically vulnerable populations; and to save healthcare dollars by preventing unnecessary ambulance transports, emergency department visits, and hospital readmissions.” The components adopted by Eagle County include: 1) primary care services, ordered by a physician and conducted in a patient’s home, and 2) community-based prevention services planned and provided in concert with the local public health department.

While Eagle County represents a very rural area, the concept has also been implemented in the urban area of Fort Worth and adjacent communities. The initial focus of the MedStar program was to decrease the frequency of 9-1-1 calls by the communities’ super users. The overuse and abuse of 9-1-1 is a universal problem for EMS systems. The project incorporates Advance Practice Paramedics (APP) to target repeat uses of the system (“overusers”) and provide the necessary social and clinical support to reduce the frequency of 9-1-1 calls. The APP enroll the patients, conduct in-depth medical assessments, collaborate with the patients’ physicians and families to develop a care plan, and provide ongoing support via home visits and phone calls. The program has resulted in a significant drop in the number of 9-1-1 calls generated by system overusers. MedStar has expanded the program for chronic illness, specifically congestive heart failure. It is also pilot-testing the program with Hospice patients.

The implementation of community EMS is dependent upon forming partnerships with community-based organizations – medical, mental health, and social programs. These collaborators include mental health, health departments, hospitals, home health, hospices, and other social agency programs.
In California, 13 sites have been selected to participate in a Community Paramedicine pilot. As of February 2014 the pilot study is still in the approval process; however it appears this program will move ahead. It is important to note that the scope of practice by the EMS provider in California is explicitly defined in both statute and regulation. These rules define both the skills and activities of EMS personnel and, the places they can be performed. All of the community paramedicine recommendations described in this report would require statutory changes to the EMS provider practice locations and alternative destinations for patients. Specific activities, which will require regulatory change:

- Transport to alternative destinations. Current rules only allow EMS transport to an acute care hospital.
- Refer or release. This practice in not allowed under current rules, except in the case where a patient actually refuses to be transported.

CP EMS providers will also need additional education for this role, policies, procedures and requisite medical direction from the CCC EMS Medical Director. Most of the requirements, policies and guideline have been developed by EMSA in preparation for its pilot project.

**Section Recommendations: Community Paramedicine**

- This design recommendation offers additional compelling evidence for developing CCC EMS legislative and lobbying capacity (Section 4.2). In-house or contracted, the future system is only as flexible, agile and responsive as the existing rules and regulations allow. When needed, legislative rule making requires subject matter expertise, law maker relationships and focus. CCC EMS requires a state governmental lobbyist or liaison to facilitate legislative change.
- Messaging: Utilizing existing relationships within Contra Costa County to influence change at the state government level is a free and efficient approach at present. To leverage these assets, CCC EMS should develop a position paper, brief or “talking points” to message this need in a format that is succinct with the desired results specified.
- Acute care facilities have the most to gain from recommended proposed changes to the state regulations and statutes. As such, CCC EMS must secure their participation in this effort.
- Active collaboration and planning with key system participants including the healthcare systems, payers, public health, EMS, communications centers, ambulance providers, and others should be initiated and maintained on a permanent basis to focus on innovative approaches to meet patient needs, provide solutions for patient navigation, and to identify needs within Contra Costa County in order to implement programs and activities to improve the continuum of care and overall community health.
HEALTHCARE INTEGRATION

The Institute of Medicine (IOM) of the National Academy of Science has concluded that the fragmentation of the delivery of healthcare services frequently results in suboptimal treatment, safety concerns, and inefficient use of healthcare resources. To ensure that scientific knowledge is translated into practice, the IOM has recommended the establishment of coordinated systems of care that integrate preventive and treatment services and promote patient access to evidence-based care.\textsuperscript{loxi}

It has been demonstrated that healthcare facilities that develop centers of excellence for specific acute illnesses or injuries improve long-term patient survival and quality of life. Centers in the evidence-based EMS system would include trauma, STEMI, pediatric, burn, and stroke centers. It is likely that the EMS systems will be required to address other acute illnesses through a system- and patient-centered approach as community health programs evolve.

The future of healthcare isn’t about service lines and departments, or narrow divisions of land, labor and capital; it is holistic, encompassing a “covered population.” A population that \textit{pre-hospital} (emphasis added) EMS systems already cover, figuratively as the safety net, and literally, in mobility and geography. One of the most compelling drivers of healthcare integration is financial. The Affordable Care Act (ACA) realigned many incentives in the provision of healthcare. However, it did not address payment issues related to EMS. This has created a misalignment of motives.

Concurrently, a barrier to EMS system change is also financial. The EMS system of the future will inevitably fail without financial alignment with the greater healthcare system. In fact the story behind many of the successes in EMS innovations is that they come with a price. Emergency departments celebrate the reduction of “frequent users” and “system abusers” by these pre-hospital programs, with the financial cost to “pre” and the reward to “hospital.” This misalignment is changing.

The Centers for Medicare and Medicaid (CMS) reports that nearly one in five Medicare patients return to the hospital within a month of discharge. CMS considers these readmissions a prime symptom of an overly expensive and uncoordinated health system. According to a Kaiser Family Foundation report, Medicare will penalize 2,217 hospitals for excessive readmissions during 2013.\textsuperscript{loxi} Table 14 lists the penalties that Contra Costa healthcare facilities face for these readmissions.
Table 14. 2013 Medicare Readmissions Penalties By Hospital

<table>
<thead>
<tr>
<th>Hospital Name</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTRA COSTA REGIONAL MEDICAL CENTER</td>
<td>0.10%</td>
</tr>
<tr>
<td>DOCTORS MEDICAL CENTER-SAN PABLO</td>
<td>0.12%</td>
</tr>
<tr>
<td>JOHN MUIR MEDICAL CENTER - CONCORD CAMPUS</td>
<td>0.00%</td>
</tr>
<tr>
<td>JOHN MUIR MEDICAL CENTER - WALNUT CREEK CAMPUS</td>
<td>0.00%</td>
</tr>
<tr>
<td>KAISER FOUNDATION HOSPITAL - ANTIOCH</td>
<td>0.00%</td>
</tr>
<tr>
<td>KAISER FOUNDATION HOSPITAL - Richmond</td>
<td>N/A</td>
</tr>
<tr>
<td>KAISER FOUNDATION HOSPITAL - WALNUT CREEK</td>
<td>0.00%</td>
</tr>
<tr>
<td>SAN RAMON REGIONAL MEDICAL CTR</td>
<td>0.32%</td>
</tr>
<tr>
<td>SUTTER DELTA MEDICAL CENTER</td>
<td>0.45%</td>
</tr>
</tbody>
</table>

The future EMS system in CCC will take the right patient, to the right place, at the right time. In the respect to hospital readmissions, the design envisions a scenario where a case manager automatically schedules a recently discharged patient for a follow up visit with a CP provider. This is a reimbursed visit. If the patient accesses 9-1-1 with a low acuity, non-emergency complaint, the call is routed to the CP, or through nurse triage. A 9-1-1 response is avoided resulting in cost savings, to the system, payer and patient. This is but one example where EMS integrates the healthcare system.

This scenario is not far outside of current reality, as stakeholders, especially healthcare payers and facilities spoke of a similar potential.

Section Recommendations: Healthcare Integration

- CCC EMS must become the champion of integration, armed with strategy, tactics and operations to provide real improvements in patient outcomes. Readmission avoidance is the major incentive for healthcare payers and providers to fund these outcomes.
- A centralized, MPDS-driven and medically directed, consolidated communications center must be realized.
- Continuity-of-care documentation (CCD) must be realized to enable healthcare integration.
NEEDS ASSESSMENT & HEALTH MONITORING

A needs assessment is a systematic process for determining and addressing needs, between current conditions and desired conditions. The gap between the current condition and wanted condition must be measured to appropriately identify a path to the future state.

A needs assessment is a part of planning processes, often used in communities to improve healthcare. By clearly identifying community needs, finite resources can be directed towards developing and implementing a feasible and applicable solution.

Both in the planning process (static) and day-to-day reality (dynamic), EMS has information about community health needs unavailable elsewhere. An EMS system, especially one based in a public health system, is uniquely positioned to provide information about current conditions and leverage resources to implement solutions.

The technology and information is available in EMS to monitor community health, identify needs, and evaluate trends. Additionally EMS can identify the impact of interventions or programs on community health. Monitoring and addressing health needs will continually focus EMS on unique circumstances existent in the community.

For these reasons, EMS system design must include needs assessment and health monitoring.

**Doctors Medical Center**

Contra Costa County is faced with the potential of Doctors Medical Center closing, due to financial insolvency. As recent as January 26, 2014, a local newspaper headline read, “San Pablo hospital’s fight for survival grows more desperate.” Concerns about this possibility were voiced throughout the Consultant’s meetings with stakeholders, noting that CCHS and CCC EMS have planned contingencies for this potential closure. The impact to the EMS system will be significant if this happens. While it is not the intent, or scope of this review to assess the potential closure, the scenario speaks to the reason CCC EMS must include assessment and monitoring as an attribute in redesign.

In preparation of a closure, CCC EMS modeled and prepared contingencies based on historic information of system activity, i.e. transport volume, time-of-day, disease or injury, etc. This modeling was dependent on electronic data. Good data requires technology and information systems to produce usable information. With an actual closure and a contingency plan in operation, the EMS system is subject to dynamic changes that may have not been anticipated in the planning process. Situational awareness of the plan success or challenges is possible with healthy information systems.

FirstWatch is one element in the CCC EMS information system toolkit that provides and distributes, dynamic system status updates. Funded by CCC EMS, it is dependent on infrastructure, implementation,
manpower and support outside of the control of the department. The software is not fully operational throughout the current system.

**Section Recommendations: Needs Assessment & Health Monitoring**

- The EMS system must complete a periodic needs assessment to serve the changing needs of the community.
- Strategy, tactics and operations must be implemented in an accountable chain of command that includes CCC EMS leadership.
- A single county EMS communications center will reinforce the future EMS system design.
EXCLUSIVE OPERATING AREAS

The State authorizes LEMSAs to create exclusive operating areas for ambulance services. These areas can be designated for emergency response and transport at either the ALS or BLS level. Some counties have included all ambulance response and transport in their established EOAs.

Contra Costa County has three exclusive operating areas (EOA). Two of the EOA correspond with the fire districts that provide emergency ALS ambulance response and transport. These are the Moraga-Orinda Fire District (MOF) and San Ramon Valley Fire Protection District (SRVF). The third EOA encompasses the remainder of the County and emergency ALS ambulance services are provided by a contracted ambulance service (AMR).

Unless, the emergency ambulance services have been provided by the same entity, or successor entity, in the same scope and manner since January 1, 1981; the provided must be selected through a competitive process. The relevant provision in the California Health and Safety Code Division 2.5 is included below for reference.

1797.224. (Creation of Exclusive Operating Areas)
A local EMS agency may create one or more exclusive operating areas in the development of a local plan, if a competitive process is utilized to select the provider or providers of the services pursuant to the plan. No competitive process is required if the local EMS agency develops or implements a local plan that continues the use of existing providers operating within a local EMS area in the manner and scope in which the services have been provided without interruption since January 1, 1981. A local EMS agency which elects to create one or more exclusive operating areas in the development of a local plan shall develop and submit for approval to the authority, as part of the local EMS plan, its competitive process for selecting providers and determining the scope of their operations. This plan shall include provisions for a competitive process held at periodic intervals. Nothing in this section supersedes Section 1797.201.

Moraga Orinda Fire District was grandfathered as the EOA provider. San Ramon’s EOA and the EOA served by AMR are awarded through a competitive procurement. There are no options allowed by the State to award exclusivity other than grandfathering (“201 or 224 rights”) or conducting a competitive process to selective the exclusive provider or providers.

The benefits of EOA include reduction in fragmentation, increased accountability, financial viability, and equity of service delivery.

Awarding exclusive operating rights to a single provider is designed to decrease fragmentation. Areas without exclusivity may have multiple ambulance services at the municipal level with varied levels of performance and capability. In non-exclusive areas ambulance calls may be rotated among providers or
other means are used to distribute the emergency requests. In a fragmented system, competition is effectively at the street level, rather than a comprehensive competitive procurement to select the best provider for the entire system. Duplication of services increases the costs of the system and multiple providers are difficult to coordinate to ensure the delivery of quality services.

One result of an effective competitive procurement of ambulance services is the ability of the EMS Agency to design and define performance expectations for the system and codify roles and responsibilities in the resulting agreement between the successful contracting ambulance service and the Agency. This publicly transparent process clearly defines what services are to be provided by the contractor, how the contractor’s performance will be monitored, consequences for non-performance, and “safety net” provisions to protect the public in the event of a contractor’s failure. This allows for increased accountability and transparency in the operations of an EMS system.

An important, and often the primary, reason for establishing exclusive operating areas is to amalgamate diverse jurisdictions into a single contiguous service area to capture available revenue for providing ambulance services. For example, rural, sparsely populated areas do not have adequate volume to financially support high quality ambulance services. By combining these low volume areas with urban and suburban regions, the total volume of ambulance transports will financially support the provision of quality EMS. Similarly, combining areas with high levels of uninsured population with regions that have greater numbers of insured patients makes the provision of ambulance services to the entire populace financially feasible.

The delivery of ambulance services in a contiguous area with adequate call volume to financially support operations results in the provision of equivalent services across the entire service area. While there will always be variations in response times based on geographic, density, and infrastructure characteristics, the services provided by a single service to all of the patients in the EOA will be of the same quality and with the same capabilities to care for the ill and injured.

The System’s ability to take advantages of the benefits of establishing EOAs while ensuring that the risks associated with depending upon a single exclusive EMS provider is dependent upon:
- the deliberate design of the EMS system and provider responsibilities,
- the completion of a fair and objective competitive process resulting in the selection of the provider best able to deliver high quality at a reasonable cost, and
- the codification of performance expectations, roles, and responsibilities in a comprehensive agreement between the provider and the LEMSA.

**Section Recommendations: Exclusive Operating Areas**

- Maintain existing EOA and do not create additional fragmentations
- If San Ramon or Moraga Orinda no longer provide ambulance transport, consolidate their EOA into the northern EOA
CONSIDERATIONS FOR THE EOA PROCUREMENT

This EMS Modernization Project involved extensive review and analysis of the current EMS System in Contra Costa County. As a result of these efforts a number of considerations have surfaced that should be included in the upcoming competitive process to select the EMS provider for EOA currently held by AMR. Some of these have been detailed in other sections of this report and are repeated here to ensure that the County addresses the items in the upcoming RFP.

Boundaries of the Exclusive Operating Areas

The boundaries of the existing EOA should be retained and the EMS system should not be further fragmented by subdividing existing EOA. If Moraga Orinda or San Ramon no longer provides emergency ambulance services, their EOA should be merged with the existing contracted northern EOA resulting from the procurement. The RFP and the resulting agreement should contain provisions addressing this possibility.

Potential Bidders

A single entity should compete for the EOA. This could be a Joint Powers Authority, joint venture, or single agency. During the consultation, there were numerous discussions and public statements regarding the potential of fire departments providing emergency ambulance services in the northern EOA. There would be no issue if fire departments competed for the opportunity to provide transporting ambulance services as long as the EOA boundary is retained and all parts of the EOA are served by the single entity.

Emergency Response Zones (ERZ)

Currently there are five ERZ identified in the northern EOA. These should be consolidated to three representing eastern, central, and western response zones. These should correspond with the contiguous areas of demand described earlier. Each of these three zones requires separate deployment plans and operational practices to effectively cover. Current zones identified as A and B should be consolidated into the western ERZ. Similarly, zones D and E should be combined to form the eastern ERZ.

The current zones are:

- ERZ A: The territory of the City of Richmond
- ERZ B: The territories of the city of El Cerrito, Kensington Fire Protections District, City of Pinole, rodeo-Hercules fire Protection District, Crockett-Carquinez Fire Protection District, and that portion of Contra Costa County Fire Protection district covering San Pablo, El Sobrante, North Richmond, and other areas of western Contra Costa County.
- ERZ C: That portion of the territory of Contra Costa County fire Protection district covering Concord, Clayton, Lafayette, Martinez, Pleasant Hill, and other areas of central Contra Costa County.
- ERZ D: That portion of the territory of Contra Costa County fire Protection District covering Antioch, Oakley, Pittsburg, Bay Point, and other areas of east Contra Costa County.
- ERZ #: The territory of the East Contra Costa County fire Protection District.

Combining the ERZ and eliminating the “two paramedic” and varying response time standards would result in an approximate annual savings of $700,000 for the Contractor.

**Response Time Requirements**

The evidence indicates that the actual response times for transporting ambulances do not significantly impact patient outcome unless they arrive within four minutes. Since this is not achievable, the focus needs to be on engaging bystanders, family members, and community volunteers as the initial first responders. The RFP should recognize these facts and allocate resources gained from relaxing ambulance response time requirements slightly to having the provider intensify community health and education efforts as part of its defined roles and responsibilities.

Realistic response time requirements for the northern EOA for life-threatening emergencies are 12:45, 90% of the time in high call density areas. The low call density areas should maintain response times of 20:00 minutes, 90% of the time. Discovery Bay and Bethel Island demonstrate pockets of high density call volume and should retain the current response requirements of 16:45, 90% of the time. Exceptions to response time performance penalization should be available for those remote calls that are eight road miles from the nearest high density area boundary.

Extending the response time requirements by 60 seconds would result in $1.1 million in annual savings for the System’s emergency ambulance service providers.

**Medical Dispatch**

The RFP should include an option for the County to have the successful contractor provide medical dispatch for the system. This would require that the county primary PSAPs transfer the call directly to the contractor’s medical dispatch center for call prioritization, pre-arrival instructions, and dispatch of the first responders and ambulances. This option would be selected if the County is unable to implement comprehensive medical dispatch for the entire northern EOA prior to the contact start date.

Current medical dispatch activities are not achieving the timeliness of notification and adequate categorization of the calls to accurately and safely determine: If alternative resources could better benefit the patient (i.e. nurse advice, referral, etc.) and whether first responders are needed for each incident.
The current dispatch centers are operated on different platforms, have varying means of notifying the ambulance services to respond, and make tracking the progress of an incident from the initial PSAP to the delivery of the patient to his or her destination difficult. The lack of a common database or at least electronic access to the various databases makes it difficult to monitor system performance, identify improvement opportunities, and to conduct research on system service delivery components to improve patient outcome and community health.

**Integrating EMS with Healthcare Systems**

The selection of a provider for the northern EOA will result in a ten-year agreement. During this decade there will likely be numerous changes in the delivery of healthcare services that will impact the EMS Contractor. The RFP and Agreement should be flexible to take advantages of opportunities to integrate the EMS providers with public health and the county’s healthcare systems.

Out-of-hospital treatment, transport to alternative destinations, follow-up of discharged patients, chronic disease monitoring, telephonic monitoring, referral to telephone advice lines, and other unforeseen services may become an important component of community healthcare. The system and its participants should be agile and incentivized to explore the alternative services and associated funding.

It is important that these collaborations be established in such a manner, that if the Contractor was unsuccessful in a subsequent bid or was no longer providing the EMS and community services, that the relationships and agreements would be retained within the System. Therefore, these agreements should be three-party arrangements including the healthcare system, Contractor, and the County.

**Elimination of Low-Value Requirements**

Services provided by the northern EOA Contractor should be reevaluated prior to developing the RFP. There are a number of activities, services, or responsibilities required of the Contractor that produce minimal value to patients and community health.

Supplemental Transport Ambulance Resource (STAR) Cars were established to allow fire department to transport patients in the event that the system’s resources were depleted. These units are not utilized and the $100,000 cost to the Contractor should be eliminated.

The Contractor is required to staff three quick response vehicles 24 hours per day. These units are located in Crockett, Brentwood, and the Byron/Discovery Bay area. As discussed earlier, the use of ALS first response cannot be demonstrated to improve patient care and outcomes. The resources required for staffing these units approximate $1.2 million annually. These units should be eliminated and the savings reallocated to additional ambulance units and EMS system support activities.
The Contractor should be required to financially support the EMS Agency’s contract administration and management costs. An annual fee should be paid by the Contractor for Agency oversight and contract management activities.

**Bi-annual Contract Review**

Since it is impossible to predict the impact of health reform changes and the direction that EMS will need to take to respond to healthcare system modifications at this time, it is important that the LEMSA and the Contractor conduct an bi-annual review of services provided under the contract, costs, pricing, and environmental changes to potentially amend or adjust the Contractor’s actions.

While these scheduled reviews should be in place, it may also be necessary to reevaluate and adjust the Contractor’s operations to respond to significant events, such as the closure of a hospital.

**Section Recommendations: EOA Procurement Considerations**

- Retain existing EOA boundaries.
- Ensure RFP allows and promotes proposals from Joint Powers Authorities, joint ventures, and singular entities with one agency responsible for the entire EOA.
- Consolidate Emergency Response Zones (ERZ) into three. Combine ERZ A and B and ERZ D and E.
- Extend ambulance response times in high density areas by 60 seconds and maintain rural and high density pocket response time levels.
- Allow exceptions from response time penalties for those incidents at least 8 road miles from the nearest high density area boundary.
- Include option of Contractor to provide medical dispatch services as the secondary PSAP if existing centers are unable to provide at the necessary performance levels.
- Encourage and incentivize the Contractor to explore alternative service delivery options and funding sources.
- Require three-party agreements for collaborative ventures for delivery of alternative services to include the County, the Contractor, and the healthcare service provider.
- Eliminate STAR cars and QRVs from the Contractor responsibilities.
- Require Contractor to pay annual fee for EMS Agency oversight and contract management services.
- Conduct bi-annual contract reviews to evaluate system changes, costs, charges, and revenue variations
- Enable the review of Contractor services and costs if significant events occur during the term of the agreement.
SYSTEM FINANCE

There are a number of different agencies and organizations involved in the emergency medical services system. This section is going to focus on the funding of two primary components. This includes the emergency ambulance transport providers and the EMS agency responsible for overseeing emergency response and transport.

Ambulance Transport Funding

There are two major sources of funding for emergency ambulance transport providers – fee for service and tax support. The majority of the funding to support transport ambulance services is derived from the revenue collected from insurers, government payers, and patients for the provision of ambulance transport. Reimbursement for emergency ambulance transport services is similar to other types of nonhospital healthcare providers’ reimbursement. There are five major factors that determine the revenue that is going to be derived from providing ambulance transport to patients within an EMS system. These include: 1) volume of chargeable events, 2) charge levels, 3) payer mix, 4) service mix, 5) competence of revenue recovery efforts. We will discuss each of these factors in more detail in the following paragraphs.

Every geographic area encompassed by an EMS system has different influencers that impact the amount of revenue that could be recovered by charging for ambulance transport.

Volume of Chargeable Events

Healthcare payers typically do not reimburse for the provision services by EMS paramedics and EMTs unless the patient is actually transported. For example, Medicare which is the largest single payer for ambulance services does not cover any treatment or actions by ambulance personnel unless the patient is actually transported.35 Therefore the amount of money that can be collected for the provision of emergency ambulance services is determined by the number of patient transports that are accomplished. Figure 9 shows the trend of ambulance transports covering the years 2009 – 2012. These events are chargeable and reimbursable for the ambulance services providers. The trend of ambulance transports continues to rise on an average of 3.5 percent per year and has increased 10.7 percent from 2009 through 2012.

35 Limited exception in that Medicare does provide reimbursement in some circumstances when the patient is deceased
A number of events may occur following a request for an ambulance. Generally, the EMS system responds, treats the patient and the patient no longer needs to be transported to a hospital. In other instances, patients or bystanders request ambulances and patients refuse transport. While SRVFPD and MOFD charge for patients who are treated and not transported, little revenue is recovered since most healthcare payers do not reimburse for these non-transport related events. While the revenue may be limited, most EMS systems have a defined charge for treat and release, or treat and no transport; it is reasonable that the EMS system approves these charges.

As EMS systems evolve into a more integrated delivery of healthcare services, it is anticipated that protocols, procedures and the standard of practice will be to identify patients that can be safely treated at the patients’ location and then released or referred to other healthcare providers. But as long as the incentives for ambulance providers are directed toward transporting patients, it will be difficult to implement these needed EMS system changes. Alternative funding sources for these types of events will be required.

**Increasing Charges**

Clearly, the more a system can charge, the more it can collect. The difference is that some of the major payers for ambulance service limit the amount that they are going to reimburse, regardless of the charge levels. The primary fee schedule payers are the governmental healthcare programs, such as...
Medicare and Medi-Cal. Once the charges exceed the fixed reimbursement levels, Medicare and Medi-Cal will not pay any more for an ambulance trip. As can be seen in Table 15, the charges for each of the emergency ambulance transport providers in Contra Costa County are above the Medicare and Medi-Cal fee schedule amounts. The rates charged vary among the three ambulance transport providers in Contra Costa County – AMR, SRVFPD, and MOFD. For example, a BLS emergency ranges from approximately $813 to $1,034. The table also demonstrates that while AMR is not allowed to charge for treat and no transport, both San Ramon and Moraga Orinda do have fees associated with assessment at the scene with no transport.

Table 15 Ambulance Rates and Reimbursement

<table>
<thead>
<tr>
<th>Description</th>
<th>AMR Charge</th>
<th>SRVFPD Charge</th>
<th>MOFD Charge</th>
<th>Commercial Allowable</th>
<th>Medicare Payment</th>
<th>Medi-Cal Payment</th>
<th>CCHP Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLS Emergency Base Rate</td>
<td>813.29</td>
<td>1,034.00</td>
<td>1,016.95</td>
<td>731.96</td>
<td>930.60</td>
<td>420.45</td>
<td>35.46</td>
</tr>
<tr>
<td>ALS 1 Emergency Base Rate</td>
<td>1,821.84</td>
<td>1,461.00</td>
<td>1,451.45</td>
<td>1,639.66</td>
<td>1,314.90</td>
<td>499.29</td>
<td>35.46</td>
</tr>
<tr>
<td>ALS 2 Base Rate</td>
<td>1,548.00</td>
<td>1,671.45</td>
<td></td>
<td>1,639.66</td>
<td>1,504.31</td>
<td>722.66</td>
<td>35.46</td>
</tr>
<tr>
<td>Loaded Ambulance Mile Rate</td>
<td>25.29</td>
<td>28.80</td>
<td>26.40</td>
<td>22.76</td>
<td>25.92</td>
<td>7.16</td>
<td>3.55</td>
</tr>
<tr>
<td>Oxygen administered</td>
<td>103.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.86</td>
<td>3.56</td>
</tr>
<tr>
<td>First Responder assessment</td>
<td>450.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Assessment at Scene</td>
<td>121.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>223.37</td>
<td></td>
</tr>
<tr>
<td>BLSM — Basic Medical Aid</td>
<td>154.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALSM — Advanced Medical Aid</td>
<td>348.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is important to recognize that increasing charges will increase revenue for the system, but it is not a dollar for dollar exchange. Increasing the charges by a dollar in 2006 would have generated approximately twenty cents of new revenue, while increasing an ambulance charge by a dollar in 2013 would generate a figure just shy of seventeen cents. This marginal collection rate is important to understand when discussing price increases.

A substantial price increase generates a limited amount of new revenue. Table 16 demonstrates the impact of raising ambulance average prices by $100 to $500 per transport.

Table 16. Price Increase

<table>
<thead>
<tr>
<th>NET INCREASE IN COLLECTED REVENUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>APC Increase</td>
</tr>
<tr>
<td>$100.00</td>
</tr>
<tr>
<td>$150.00</td>
</tr>
<tr>
<td>$200.00</td>
</tr>
<tr>
<td>$250.00</td>
</tr>
<tr>
<td>$300.00</td>
</tr>
<tr>
<td>$350.00</td>
</tr>
<tr>
<td>$400.00</td>
</tr>
<tr>
<td>$450.00</td>
</tr>
<tr>
<td>$500.00</td>
</tr>
</tbody>
</table>
The charges approved for the providers in Contra Costa County are lower than charges seen in other northern California counties. Information provided by AMR compares their company’s charges in various counties where they are the contracted EOA provider (Table 17). The final column identifies the average patient charge (APC) for an emergency ALS ambulance transport. This is the most relevant comparison between the listed counties. Contra Costa County is the second lowest of the counties presented. The Contra Costa County APC is nearly $600 lower than the average charged in the other counties.

Rate increases have been limited in Contra Costa County due to the provisions of the contract which limits increases to the greater of the CPI or 2.5% and is limited to no more than five percent. Over the past decade that the contract has been in place, the inflation of healthcare costs have greatly exceeded the CPI. EMS and ambulance services is a blend of two industries (healthcare and transportation) with the largest single expense being allocated to personnel. It is clear that costs in the Contra Costa EMS system are increasing at a greater rate than the fee increases, particularly when increases generate only 17% in new revenue.

Table 17. AMR’s Northern California Ambulance Rates

<table>
<thead>
<tr>
<th>COUNTY</th>
<th>ALS BASE RATE</th>
<th>BLS BASE RATE</th>
<th>MILEAGE RATE</th>
<th>O2 RATE</th>
<th>ALSE APC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Napa County</td>
<td>$1,623.88</td>
<td>$1,184.50</td>
<td>$33.61</td>
<td>$116.02</td>
<td>$1,817.44</td>
</tr>
<tr>
<td>Contra Costa County</td>
<td>$1,821.84</td>
<td>$1,821.84</td>
<td>$25.29</td>
<td>N/A</td>
<td>$1,984.69</td>
</tr>
<tr>
<td>Yolo</td>
<td>$1,975.00</td>
<td>$233.36</td>
<td>$78.57</td>
<td>$340.85</td>
<td>$3,092.98</td>
</tr>
<tr>
<td>Placer County</td>
<td>$1,696.52</td>
<td>$944.56</td>
<td>$39.12</td>
<td>$166.73</td>
<td>$2,297.07</td>
</tr>
<tr>
<td>Sonoma County</td>
<td>$1,600.59</td>
<td>$1,239.62</td>
<td>$34.13</td>
<td>$149.98</td>
<td>$2,320.27</td>
</tr>
<tr>
<td>San Joaquin County</td>
<td>$2,033.15</td>
<td>$1,733.89</td>
<td>$43.14</td>
<td>$126.90</td>
<td>$2,401.76</td>
</tr>
<tr>
<td>San Francisco County</td>
<td>$1,816.86</td>
<td>$1,388.86</td>
<td>$40.66</td>
<td>$185.32</td>
<td>$2,507.59</td>
</tr>
<tr>
<td>Santa Cruz County</td>
<td>$1,790.92</td>
<td>$1,790.92</td>
<td>$56.90</td>
<td>$206.33</td>
<td>$2,441.19</td>
</tr>
<tr>
<td>San Mateo County</td>
<td>$2,101.21</td>
<td>$1,379.00</td>
<td>$51.03</td>
<td>$191.63</td>
<td>$2,791.20</td>
</tr>
<tr>
<td>Stanislaus County</td>
<td>$2,322.18</td>
<td>$1,655.03</td>
<td>$48.44</td>
<td>$201.34</td>
<td>$2,810.06</td>
</tr>
<tr>
<td>Shasta</td>
<td>$2,067.06</td>
<td>$1,389.35</td>
<td>$60.10</td>
<td>$256.53</td>
<td>$2,837.86</td>
</tr>
<tr>
<td>Monterey County</td>
<td>$2,327.84</td>
<td>$2,327.84</td>
<td>$50.21</td>
<td>$150.08</td>
<td>$3,373.53</td>
</tr>
<tr>
<td>Average</td>
<td>$1,931.42</td>
<td>$1,424.06</td>
<td>$46.77</td>
<td>$190.15</td>
<td>$2,556.30</td>
</tr>
</tbody>
</table>

Rates effective 2-1-2014

Payer Mix
The payer mix is very important when determining the revenue that will be generated from healthcare payers for emergency medical services. For decades, healthcare reimbursement has been defined by cost shifting. By that we mean that the uninsured, underinsured, and some governmental payment programs do not reimburse the cost of providing services. Therefore, healthcare providers have relied on commercial insurance companies to pay more than the costs to help cover the shortfall. As healthcare providers, ambulance services have had to utilize the same strategy where the commercial insurance payers pay significantly higher levels of reimbursement than governmental payers and
substantially more than the state Medicaid programs such as Medi-Cal. Commercial insurance payers, and to the lesser degree, Medicare, have to cover the cost of providing the services to the uninsured.

Figure 10 reveals a disturbing trend for the majority of the patients transported in Contra Costa County. In 2005 commercial insurers accounted for over 35 percent of the total of revenue produced within the County while approximately 42 percent were covered by governmental programs such as Medicare and Medicaid. In 2013 this dramatically shifted. Commercial insurance now accounts for less than 16 percent of the revenue for the system, while government payers are approaching 64 percent. As indicated earlier, the governmental payers pay according to a fee schedule. So, regardless of what rates are being charged, there will be no increase in revenue per transport from these payers.

Figure 10. Payer Mix Changes

The other challenging position represented by the change in the payer mix is that now the EMS system can no longer cost shift its shortfalls in reimbursement to the commercial insurance payer since it represents less than 16 percent of the revenue generated for the programs.

The four major payer categories for the contracted EMS provider include government payments, self-payments or those fees directly paid by patients, contracted insurance and third party insurance. The
third party insurance represents the commercial insurance payers in Contra Costa County, including Kaiser Permanente.

The previous table provides an example of expected reimbursement from the various types of payers for the emergency ambulance providers in Contra Costa County. For example many commercial payers pay 80-100 percent of an emergency ambulance charge. If the commercial payers pay 90 percent of the base rates the providers would receive between $730 and $930 for a BLS emergency base rate. Between $1,300 and $1,600 for an ALS emergency base rate and between $1,500 and $1,600 for an ALS 2 base rate. Mileage is based on a loaded patient mile and ranges from $25.29 per mile to $28.80 per mile.

The table above reveals the impact on revenue potential from the government fee schedule payers. For example, all of the providers would receive 80 percent of the allowable Medicare amount. The Medicare allowable for a BLS emergency base rate is $420.45, for the ALS emergency base rate Medicare allows $499.29, and an ALS Level 2 call would receive $722.66 in Medicare reimbursement. The mileage allowed by Medicare is $7.16 per mile. It is important to understand that a Medicare allowable is the fee schedule amount determined by Medicare for reimbursement of ambulance services. Medicare reimburses 80 percent of that allowable and expects the patients to pay the 20 percent co-insurance, plus an annual deductible. Therefore the actual Medicare payment would be $336.36 for a BLS base rate, $399.43 for an ALS base rate, $578.12 for an ALS level 2 base rate, and $5.73 per patient-loaded mile.

The Medi-Cal payment rate was established in 2002 and represents an amount that is significantly less than the cost providing services. Medi-Cal does not recognize the difference between ALS and BLS. So, for an emergency ambulance call, the provider can expect to be reimbursed $118.20 regardless of the level of service. The ambulance service would also be reimbursed $3.55 per loaded patient mile and if utilized, $11.86 for oxygen administration. Recently the state of California has reduced Medi-Cal payments by 10 percent so the actual payment by Medi-Cal would be 10 percent less than the amounts listed in the table.

Another challenge for ambulance providers is represented by the patients who are the County’s responsibility or who are covered under the Contra Costa Health Plan. Ambulance transports (ALS or BLS) are paid at 30 percent of the Medi-Cal rates. Therefore, an ambulance base rate would be reimbursed at approximately $35.00 for these patients. This volume is growing from 1,063 transports in 2012 to an estimated 1,132 transports in 2013. The reimbursement represents a fraction of the direct cost to complete these transports. Continued growth, without additional reimbursement, requires that the ambulance provider subsidize the health plan member costs.

Figure 11 demonstrates the significant increase in Medicare payments in 2006, 2007 and 2008 and the continual increases for Medi-Cal which has resulted in 43 percent of the persons transported in the contracted EOA being covered by Medicare, 22 percent being covered by Medi-Cal, and only six percent of the patients are covered by a commercial insurance company.
The increase in government program payers and decrease in commercial insurance has resulted in limited reimbursement for ambulance services. Figure 12 shows that while the charges have increased from 2007 through 2013 by more than $800, the actual amount collected per transport has remained flat at approximately $575 per transport.
In response to the Accountable Care Act, California is increasing its Medi-Cal rolls. This increase in individuals covered by Medi-Cal will continue to increase the percentage of patients covered by governmental programs. There may be some benefit in the short term if these patients previously had no insurance and their ambulance transports were not generating any revenue. Yet, if the shift starts encroaching on the commercially covered patients, then the revenues will remain flat or decline.

**Service Mix**

Another important factor in determining reimbursement is the level of service being billed. Primarily the two different levels are ALS and BLS. Medicare allows approximately $80 more per trip when it is billed at the ALS level versus BLS. Medicare and other payers also recognize a higher level of ALS called ALS 2. The ALS 2 level is reimbursed approximately $220 more than the ALS emergency level. This service mix is important because it determines the total amount of revenue that would be available for a provider. In a system devoted to 9-1-1 emergency responses approximately 10-20 percent of the transports should be filed at the BLS emergency level rather than as an ALS emergency.

**Competence of Revenue Recovery Efforts**

The fifth factor which is not covered in this review is the level of competency of each of the providers or their billing services in recovering the potential revenue from the various healthcare payers. Diligent
efforts by those responsible for filing insurance and governmental payer claims and following up on accounts can impact the amount of revenue that is collected. The rules and regulations governing reimbursement for ambulance services are strict and complex; it is important that the providers, whether they perform the function or outsource billing and collection, monitor and insure that the efforts on their behalf are done in a compliant and effective manner.

**EMS System Funding**

Oversight, coordination, and support for the EMS system are provided by Contra Costa Heath Services through its EMS agency. The programs and activities performed by the EMS agency are largely funded through tax support and fees. As demonstrated in Figure 13, 70 percent of the agency’s revenue is generated by the Measure H parcel tax to support EMS enhancements. Eighteen percent or $1.2 million is derived from the Hospital Preparedness Program (HPP) grants and these funds are largely dedicated to specific activities required by the grant. The EMS Fund, Senate Bill 12, generates a little over $400,000 or six percent of the overall income, and another six percent or $400,000 is generated through other fees for trauma center designation, STEMI Stroke center designation, and certificates, etc.

**Figure 13. Revenue Sources**

Measure H is a County residential parcel tax. Two separate zones are subject to the tax--Zone A, which represents San Ramon Valley Fire Protection District’s area, and Zone B, covering the rest of the County. County finance estimates that Measure H will generate approximately $220,000 a year in San Ramon Valley and the remainder of the County will generate approximately $4.5 million per year from Measure H receipts. Measure H amounts per benefit unit are $3.94 in Zone A and $10 in Zone B. Approximately $2.6 million of the Measure H fund is used to support fire first responders. The remainder of the funding is used to support the numerous programs and activities of the County and its EMS agency.
Figure 14, representing data provided by the EMS agency, shows the estimated programmatic costs for the activities that it performs. The next graphic, Figure 15, eliminates the first responders support funding to more clearly demonstrate the numerous activities and programs that are supported by the Measure H and other funding sources. The Hospital Preparedness Program (HPP) provides leadership and funding through grants to improve surge capacity and enhance community and hospital preparedness for public health emergencies. This program is designed to enhance planning and integration of healthcare facilities and providers to increase preparedness, response, and surge capacity of hospitals and other care facilities. Contra Costa County receives approximately $1.2 million in its most recent HPP grant. The vast majority of these funds are used and dedicated specifically to accomplishing the HPP requirements.

Figure 14. EMS Annual Program Support

36 https://www.phe.gov/Preparedness/planning/hpp/Pages/overview.aspx
In the last fiscal year, the County received approximately $425,000 from the state EMS Fund, generated by Senate Bill 12. The SB 12 funds have been decreasing and may sunset after 2014 if they are not reestablished.

Another $400,000 is generated annually through other fees and grants. These include the trauma, STEMI, and stroke designation fees. A variety of other fees are collected through the EMS agency for ambulance permits, certification fees and other miscellaneous revenue. The EMS Agency estimates that the enacting of a new County ordinance will increase fees for inspections and ambulance permits, but this still will represent a small portion of the EMS agency’s budget.

EMS receives a little over $7 million in revenue annually to provide the support and services to the County and the EMS system. Expenditures are also approaching $7 million as demonstrated in Figure 16. As demonstrated by the trend lines, the revenue and expenditures for the County EMS agency from fiscal year 2002 – 03 to fiscal year 2012 – 13 have tended to increase slightly over that period. The expenditures are converging on the total revenues. With everything remaining constant, the trend line reveals that in the next 8-10 years the expenditures would exceed the available revenue.
Section Recommendations: System Finance

- There is little that can be done to increase what the governmental payers reimburse for ambulance services. This is a nationwide issue. In January, 2014 Medi-Cal cut its reimbursement by 10%. This continues to exacerbate the problem. Only continued lobbying on a state and national basis can achieve any results.

- The rates in Contra Costa County are significantly below the rates in other counties served by AMR. It is recommended that rates be elevated closer to the average or median of the rates charged in the Bay area. In addition, the County should allow treat and no transport charges for all of the emergency ambulance providers.

- Contra Costa County and its EMS providers should strive to capture alternative funding to reduce the sole dependence upon transport revenue. This will be a long-term effort and would seek reimbursement from payers and healthcare systems that are not traditional, but in keeping with CP and mobile integrated healthcare programs. The services that may be implemented for alternative reimbursement should be based on the expansion of the roles of EMS, but are dependent upon a discreet process in collaboration with other healthcare providers to identify needs and potential solutions that could be included in the EMS provider roles.

- Since the ability to generate more revenue is limited, every effort should be focused on reducing costs, especially for low-value activities and those functions performed that lack evidence in benefiting the patients and community.
THE MODERNIZATION OF EMS IN CONTRA COSTA COUNTY

The term “Emergency Medical Services” does not adequately describe the modern concept ascribed to EMS. Modern EMS comprises much more than the emergency response to an acute event and the mitigation of the incident. It encompasses a broad reach of activities including prevention, education, public health, patient navigation, safety net provisions, access to healthcare, integration of healthcare services, and much, much more. The results of this project are designed to provide a roadmap for the Contra Costa County system. It does not represent a one-time change or implementation of specific components but a guide on how to respond to the system’s future needs.

As the project evolved there were a number of specific characteristics that guided the consultant to focus on the important and strategic outcomes envisioned. The attributes of the modernized system for Contra Costa County include:

- Patient and constituent centered
- Evidence based
- Agility
- Value driven
- Transparent
- Accountable

**Patient and Constituent Centered**

The overriding premise that the consulting team maintained throughout the project was to evaluate each aspect of the EMS system and the recommendations to ensure that they were focused on what is best for the patient as well as the residents and visitors to Contra Costa County. Ultimately if a consideration for a recommendation was examined and it did not result in a benefit to the patient or the constituents within the county it was not included for consideration in the system design. Often, EMS systems and their design have evolved based more on the goals and agendas of the participating agencies rather than maintaining a focus on the true reason for the delivery of the services to improve patient outcomes and benefit the community.

**Evidence Based**

It is also true that EMS systems have changed over time into directions that were believed to improve patient outcomes with regard to mortality and morbidity that were not based on evidence or adequate research. In this process, assumptions, beliefs, and anecdotes drove the inclusion of specific patient interventions and delivery systems. Over time many treatment modalities or medications were found not to benefit the patients and in some cases actually harm the patients. Of course, these activities were phased out of EMS system delivery.
There are two basic premises that have pushed the development of EMS systems and have focused designers and agencies involved in a specific direction where modern research and evidence indicates that the value placed on these aspects are not as beneficial as expected.

For the last 40 years EMS systems have focused on increasing the deployment of advanced life support paramedics and shortening response times to emergency events. Neither of these goals has demonstrated the favorable patient outcomes that were expected. In fact, research has indicated that while response times are important, the range of appropriate response times that has positive patient impacts are longer than many of the EMS system goals.

EMS systems were initially designed around the impact on patient survival from cardiac arrest, where studies anticipated that if ALS arrived within 8 minutes there would be positive patient outcome. Subsequent research has indicated that bystander CPR and automatic defibrillation are the true forecasters of patient survival.

As referenced earlier, subsequent research has shown that response times as long as 14 minutes do not have a negative impact on patient outcomes.

Many EMS systems have striven to increase the availability of advanced life support both at the transporting ambulance level and the first responder level. There is little evidence that ALS at the first responder level impacts patient outcomes particularly if ALS is responding in ambulances within a few minutes of the first responders. Evidence has shown that certain treatments do have a positive impact on patient outcomes from prompt first response, particularly automatic deliberation. Again as we look through the recommendations developed in this study it is paramount that we focus on what benefits the patient and eliminate those activities that divert resources and provide minimal benefit.

The continuum of care and the systems approach to specific patient circumstances have demonstrated dramatic impact on the outcome of patients. This is demonstrated in the acute heart attack (STEMI) programs, stroke programs, trauma programs, and cardiac arrest. EMS systems should focus on the continuum that includes education, bystander participation, public access to automatic deliberation, first responders, transporting entities, and receiving facilities. Without the coordination of all these participants none of the desired outcomes can be achieved. Contra Costa County’s EMS system has demonstrated significant improvement in patient outcome with the implementation, monitoring and execution of the continuum of care system approach in specific patient illnesses or injuries.

**Agility**

To say that the delivery of healthcare services is changing is an understatement. Dramatic upheavals in healthcare delivery systems are occurring almost on a daily basis. The full impact of health reform and the Accountable Care Act has not been realized and cannot be predicted at this time. Therefore EMS
system must have the characteristic of being agile and flexible to respond to the changes as they occur to become valuable integrated participants in the delivery of health care services.

Opportunities will arise within the term of the next contract that are not now envisioned or predictable. But it is important that the system and the resulting contracts between the EMS system providers allow for the flexibility to redirect system efforts and change the services delivered and provided by the system in order to respond to these health care reform changes.

The EMS structure now is static with the transporting ambulance services being very restricted in how they can integrate themselves with evolving health care system. Incentives and agreements in the system design should encourage innovations for the system participating agencies to be able to become an important part in the provision of health care services. The reality that EMS systems provide the safety net for the community’s residents that require health care, access to healthcare for those that don’t have previous relationships, and response to those emergency acute events. It is necessary to maintain this infrastructure while allowing the involvement of the ambulance services to not be restricted to picking up patients and transporting them the most appropriate acute care hospital.

**Value Driven**

One of the important considerations when anticipating a system design change, and particularly to position the system for positive movement in the future period is the financial considerations. Funding sources from all aspects for EMS are limited and it is not expected that these sources are going to dramatically increase and in fact they may ultimately be decreasing. One of the primary objectives of the ACA and other health care reform is to reduce costs. These pressures are going to continue over the next several years which may reduce the primary funding mechanism for much of the system in the form of lower reimbursement for fees for service. There is also strong pressure particularly in Contra Costa County not to increase the public funding for emergency services. Therefore, it is important that the resources that are available should be directed to those activities within the system that provide value.

**Transparent**

The EMS Agency publishes annual reports and shares system performance information on a regular basis. The county Emergency Medical Care Committee (EMCC) is made up of representatives from stakeholders and the public and is actively involved in reviewing system activities and performance.

These activities are important and should be continued. In addition, as EMS and out-of-hospital care evolves and the system enlists additional community support, additional efforts should be focused on sharing information with county constituents and decision-makers.
**Accountability**

All aspects of EMS and out-of-hospital care require the participants to be held accountable for their responsibilities. Areas that should be monitored include: community education and involvement, preventive programs, call receipt and dispatch, bystander and formal first response, ambulance response and transportation, and receiving facility actions.

In order to hold participants and the System accountable, it will be necessary to establish a comprehensive and integrated information system where actions are documented in standardized formats and electronic systems, key indicators are identified, data is collected and retrieved, analysis is performed, and procedural modifications are implemented based on results. While these steps are straightforward, the actual implementation of such a program is complex and will require the collaborative efforts of all agencies involved.

Regular reporting of System performance to the individual agencies and the public should occur on a regular basis.

**Recommendations for the Future**

This report contains many recommendations. The most important for the modernization of the out-of-hospital and EMS system for Contra Costa County are described in this section. Many of the recommendations combine those previously delineated in the report while some have not been previously addressed. We have categorized the recommendations and some are related while others are dependent.

**Patient and Community Benefit**

The following recommendations are focused on areas to improve patient outcome and community health.

- Continue and expand prevention efforts through enhancing community involvement in CPR, symptom awareness, disease management and other types of efforts to reduce incidence of injury and illness, and to enlist bystander participation in assisting in acute events. Specific programs include public CPR training and public access defibrillation programs.

- Match patient needs with appropriate resources. Many individuals accessing EMS do so because they do not believe they have alternatives for receiving healthcare services. This is a long-term recommendation in that it will require implementing other recommendations, the collaborations of healthcare providers (i.e. clinics, social services, etc.), and state regulation and/or legislative support.

- Develop alternative first responders in areas where fire responders are not quickly available. Volunteers can be recruited from existing programs, community groups, industry, and community members to receive appropriate first responder training. Funds should be allocated
to provide these responders with appropriate medical equipment and supplies to deliver these services.

**Base Activities on Evidence**

- Focus on systems approaches to care of the sick and injured with collaboration of all levels of providers to ensure an effective continuum of care. Provide additional technology to facilitate collection and sharing data, allow effective monitoring and reporting, and to measure results.
- Design first response at the BLS level and AED as the minimum for organized first responders. Expand first response to volunteers at the First Responder level with AED.

**Enhance Agility to Respond to Healthcare Changes**

- Consolidate medical communications into a single center. The center should allow for quality processing of medical requests using state of the art priority dispatching procedures, quality assurance, and simultaneous dispatch of necessary resources. A solid infrastructure, interoperable communications capability, and extensive data collection and management are essential. Available options include consolidation of existing centers, establishing a joint powers authority to operate the center, or outsourcing the function to a qualified provider.
- Introduce alternatives for patient fulfillment such as access to nurse advice lines, referral to other agencies or providers, etc. This recommendation is dependent upon developing a quality medical communications center and creating new collaborations with other healthcare providers.
- Create incentives and eliminate obstacles in agreements between CCC EMS and its providers. Specifically, the EOA contractor should be allowed to bring innovative strategies to expand integrated health care delivery by developing relationships with other healthcare providers to introduce new options and services that may be compensated for outside of the typical fee for transport.

**Ensure Value**

Every aspect of service delivery in the EMS system should withstand a cost / benefit analysis. This mechanism allows decision makers to objectively reduce high cost / low value activities and to increase those activities that provide the greatest benefits to the patients and the communities.

- Dispatch first responders only to events that will benefit from their prompt delivery of care. This is dependent upon a quality medical communications center to be able to accurately and safely prioritize the calls.
- Extend transport ambulance response times by 60 seconds for high density areas. Evidence does not support improved patient outcomes, ambulances are arriving at the scenes nearly at the same time as the first responders, and cost savings can be redirected to efforts that produce greater benefit.
- Standardize performance requirements of the transporting ambulance service in the EOA. Unique requirements in the City of Richmond with shorter response times and two paramedics
cannot be supported by evidence and they create a costly operational situation that is operationally difficult.

- Consolidate EOA ambulance zones into three (East, Central, and West) that conform to the incident demand patterns. Reducing the zones from five to three introduces savings and enhances operations when the zones correspond to contiguous areas of demand.
- Eliminate programs with minimal value such as the support of Supplemental Transport Ambulance Resource (STAR) Cars
- Eliminate the QRV units staffed with a single paramedic in specific areas of the County. As indicated earlier, the benefit of ALS first response does not outweigh the costs. Efforts should be made to create alternative first responder resources in these areas

Enhance Transparency

- Continue to share EMS System performance information on a regular basis through the EMCC and other public venues.
- Broaden the sharing of information regarding the system through other public avenues and target disseminating information regarding the impact on EMS and out-of-hospital care from changing healthcare delivery initiatives.

Ensure Accountability

Each system participant has specific roles and responsibilities to patients and community health. The EMS Agency should monitor and report on these activities.

- Establish standardized documentation formats and platforms for collecting and sharing information
- Identify the metrics to be monitored and measured
- Analyze performance of the System based on patient and community health benefits
- Report findings of the analyses
- Modify procedures or protocols to address areas needing improvement
CONCLUSION

The County in undertaking this project is to be commended. It was not a review responding to a crisis but a proactive engagement to guide EMS in defining the future. The County EMS system has performed consistently well for the past decade and is expected to meet the needs of patients and constituents in the future.

The timing for this review is important for identifying trends, particularly in funding, that may have resulted in future problems. Recognition of these issues now allows for System adjustments to improve the value of the services being provided, eliminating waste, and positioning County EMS to take advantage of future alternative funding sources.

Patients and community members will continue to benefit from the efforts of agencies providing essential services with all providers focusing on the continuum of care of individuals during episodic emergency incidents as well as the ongoing efforts to enhance prevention and awareness.

The delivery of healthcare services, including EMS, will change dramatically over the next decade and Contra Costa County should be prepared to initiate new services and to respond to external influences. The embracing of System agility will be critical to excel in the delivery of the right services, at the right time, at the right location to meet the unique needs of every patient utilizing EMS within Contra Costa County.
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ii NHTSA, Emergency Medical Services – Agenda for the Future, 2010

iii HRSA, rural and Frontier Emergency Medical Services Agenda for the Future: a Service Chief’s Guide to Create Community support of Excellence in EMS, 2004

iv EMS Agenda for the Future, pg i

v EMS Agenda for the Future

vi Nat’l Conf. of State Legislatures, 2012


viii NEMSAC Advisory, Evidence Basis for EMS System Design, 31 May 2012.

ix Goodloe, JM, Thomas SH (ed). EMERGENCY MEDICAL SERVICES EVIDENCE-BASED SYSTEM DESIGN WHITE PAPER FOR EMSA, July 2011


xxii Jeffrey L. Saver, MD; Eric E. Smith, MD, MPH; Gregg C. Fonarow, MD; Mathew J. Reeves, PhD; Xin Zhao, MS; DaiWal M. Olson, PhD, RN; Lee H. Schwamm, MD. The “Golden Hour” and Acute Brain Ischemia: Presenting


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xiv Barger, J. Proposed Modification to Emergency Medical Dispatch in Contra Costa County, 08 July 2013.


Appendix 1  
CAD Data Analysis

Receipt of Data
Data from American Medical Response (AMR) and from the San Ramon Fire Protection District (SRV) was received as *.xls filetypes. Data from the Contra Costa County Fire Protection District (CON) was received as a *.mdb filetype. Data from the Richmond Fire Department (RMD) was received as both *.xlsx and *.dbf filetypes.

Input of Data
Databases were created in Filemaker Pro Advanced, version 13.0, running in the Macintosh OS X 10.9.1 operating system on a 2.6 GHz quad core i7 Intel processor in a MacBook Pro laptop. In the interest of computational speed, the intent was to work exclusively with data in the native Filemaker format, *.fmp12.

The *.xls and *.xlsx filetypes were input directly into Filemaker. Data from the *.mdb file was imported into Filemaker using an all-inclusive query constructed using both Filemaker ODBC and Actual Access ODBC drivers.

Imports of all data occurred smoothly except for certain timestamps. Timestamps in the SRV *.xls files were corrupted. In particular, the year portion of all date fields was incremented by +4. A repair algorithm was constructed to parse out the year and do the needed arithmetic. The CON *.mdb file was subtly corrupted. In particular, the seconds digits of all timestamps were not accessible to either ODBC driver. The work-around was to export the CON *.mdb file to a flat tab-delimited textfile, parse out the text strings, convert them back to timestamp format, and finally merge them back into the Filemaker CON datafile.

Treatment of Data
Data from each agency was used to construct five databases. Identifying corresponding records in two databases when two agencies were involved in an incident proved to be a difficult problem that was not completely solved.

Establishing a correspondence between incidents in the ConFire and Richmond CADs with the AMR CAD data was the first problem. The ConFire and Richmond CADs use difference data sources for connecting a street address to a latitude and longitude than does the AMR CAD. The consequence is that latitudes and longitudes are not useful for identifying corresponding incidents between AMR and CAD data from Richmond and CON.

The work-around was to use multiple comparisons based on the calendar date, hour-of-day, and street address to identify corresponding incidents. Different formats for logging street addresses into the AMR CAD and the CON RMD CADs impeded this
APPENDIX 1

process. An algorithm was created to parse AMR and RMD CAD street addresses and convert them to ConFire CAD format.

About 85% of the AMR addresses were successfully reformatted to be identifiable in the CON CAD, and 70% with the RMD CAD data.

AMR records 7/1/2012 ... 6/30/2013 with FCFD as call source
Correspondence to CON CAD reconstructed from date, hour-of-day, and reformatted street addresses

Correspondence to AMR CAD reconstructed from date, hour-of-day, and reformatted street addresses

RMD incidents 7/1/2012...9/6/2013 showing AMR verified
Correspondence to AMR CAD reconstructed from date, hour-of-day, and reformatted street addresses

Response times were calculated using a custom algorithm for ranked 90%-percentiles. This approach is best suited for evaluating statistics for small numbers of incidents because it is most resistant to distortions induced by small numbers of long duration outliers.

Incident Types and Priority Codes
All five agencies in the County use different descriptors for incident types and priority codes. Incident types and priority codes encountered in these analyses are presented in below:

Incident Types and Priority Codes
Table 1. AMR-CON Incident Types

<table>
<thead>
<tr>
<th>Priority Code</th>
<th>Priority Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>ALS Life Threatening Emergency</td>
<td>49,084</td>
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<tr>
<td>A2</td>
<td>ALS Urgent Transfer</td>
<td>233</td>
</tr>
<tr>
<td>A3</td>
<td>ALS-STAT Non Emergency</td>
<td>20,364</td>
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<tr>
<td>C3</td>
<td>CCT-STAT Non Emergency</td>
<td>3</td>
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</table>
Table 2. AMR-RMD Incident Types

<table>
<thead>
<tr>
<th>Priority Code</th>
<th>Priority Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>ALS Life Threatening Emergency</td>
<td>12,068</td>
</tr>
<tr>
<td>A2</td>
<td>ALS Urgent Transfer</td>
<td>545</td>
</tr>
<tr>
<td>A3</td>
<td>ALS-STAT Non Emergency</td>
<td>3,863</td>
</tr>
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<td>A5</td>
<td>ALS Unscheduled Transfer</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td><strong>16,477</strong></td>
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</table>

Table 3. All AMR Priority Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Priority Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>ALS Life Threatening Emergency</td>
<td>58,390</td>
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<tr>
<td>A2</td>
<td>ALS Urgent Transfer</td>
<td>14</td>
</tr>
<tr>
<td>A3</td>
<td>ALS-STAT Non-Emergency</td>
<td>24,168</td>
</tr>
<tr>
<td>A4</td>
<td>ALS Prescheduled Transfer</td>
<td>1</td>
</tr>
<tr>
<td>A5</td>
<td>ALS Unscheduled Transfer</td>
<td>4</td>
</tr>
<tr>
<td>B2</td>
<td>BLS Urgent Transfer</td>
<td>6</td>
</tr>
<tr>
<td>B3</td>
<td>BLS-STAT Non-Emergency</td>
<td>2</td>
</tr>
<tr>
<td>B4</td>
<td>BLS Prescheduled Transfer</td>
<td>0</td>
</tr>
<tr>
<td>B5</td>
<td>BLS Unscheduled Transfer</td>
<td>0</td>
</tr>
<tr>
<td>C3</td>
<td>CCT-STAT Urgent Transfer</td>
<td>4</td>
</tr>
<tr>
<td>S3</td>
<td>SPECIAL-STAT Non-Emergency</td>
<td>1</td>
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### Table 4. CON Incident Types

<table>
<thead>
<tr>
<th>Incident Types</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td>5150 PD Request</td>
<td>583</td>
</tr>
<tr>
<td>EMS-ALPHA Code 2 with Engine</td>
<td>2,112</td>
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<tr>
<td>EMS-BRAVO</td>
<td>6,104</td>
</tr>
<tr>
<td>EMS-CHARLIE</td>
<td>10,691</td>
</tr>
<tr>
<td>EMS-DELTA</td>
<td>16,179</td>
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<tr>
<td>EMS-DELTA WITH HELICOPTER</td>
<td>3</td>
</tr>
<tr>
<td>EMS-ECHO</td>
<td>719</td>
</tr>
<tr>
<td>EMS-HAZ MAT</td>
<td>2</td>
</tr>
<tr>
<td>EMS-OMEGA NO RESPONSE</td>
<td>1</td>
</tr>
<tr>
<td>VEH ACCIDENT Motorcycle</td>
<td>176</td>
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</table>

Includes EMS Mutual Aid In-Bound and Out-Bound

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CON EMS Incidents</strong></td>
<td><strong>36,570</strong></td>
</tr>
</tbody>
</table>

### Table 5. CON Priority Codes.

<table>
<thead>
<tr>
<th>Priority Codes</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-Emergency</td>
<td>13,245</td>
</tr>
<tr>
<td>P2-Emergency</td>
<td>14,276</td>
</tr>
<tr>
<td>P3-Routine</td>
<td>6,052</td>
</tr>
<tr>
<td>P5-Non Emergency</td>
<td>2,978</td>
</tr>
<tr>
<td>P7-Pending ProQA</td>
<td>18</td>
</tr>
<tr>
<td>P8-No Response</td>
<td>1</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CON EMS Priority Codes</strong></td>
<td><strong>36,570</strong></td>
</tr>
</tbody>
</table>
### Table 6. MOR Incident Types

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>5150 PD Request</td>
<td>52</td>
</tr>
<tr>
<td>EMS - ALPHA CODE 2 WITH ENGINE</td>
<td>82</td>
</tr>
<tr>
<td>EMS-ALPHA *** CODE 2 ***</td>
<td>168</td>
</tr>
<tr>
<td>EMS-ALPHA Code 2</td>
<td>158</td>
</tr>
<tr>
<td>EMS-ALPHA Code 2 with Engine</td>
<td>76</td>
</tr>
<tr>
<td>EMS-BRAVO</td>
<td>349</td>
</tr>
<tr>
<td>EMS-CHARLIE</td>
<td>498</td>
</tr>
<tr>
<td>EMS-DELTA</td>
<td>593</td>
</tr>
<tr>
<td>EMS-ECHO</td>
<td>23</td>
</tr>
<tr>
<td>EMS3-AMBULANCE ONLY</td>
<td>1</td>
</tr>
<tr>
<td>RESCUE EXTRICATION</td>
<td>15</td>
</tr>
<tr>
<td>RESCUE OFF ROADWAY</td>
<td>3</td>
</tr>
<tr>
<td>VEH ACCIDENT MOTORCYCLE</td>
<td>10</td>
</tr>
<tr>
<td>VEHICLE ACCIDENT</td>
<td>71</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,099</strong></td>
</tr>
</tbody>
</table>

### Table 7. MOR Priority Codes

<table>
<thead>
<tr>
<th>Priority Code</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-Emergency</td>
<td>529</td>
</tr>
<tr>
<td>P2-Emergency</td>
<td>680</td>
</tr>
<tr>
<td>P3-Routine</td>
<td>347</td>
</tr>
<tr>
<td>P5-Non Emergency</td>
<td>540</td>
</tr>
<tr>
<td>P8-No Response</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,099</strong></td>
</tr>
</tbody>
</table>

### Table 8. RMD Priority Codes

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
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<tbody>
<tr>
<td>Medical Priority 1</td>
<td>8,466</td>
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<tr>
<td>Medical Priority 3</td>
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<tr>
<td>Medical Priority 5</td>
<td>43</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>8,510</strong></td>
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</table>
### Table 9. SRV Priority Codes

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>AED Activation</td>
<td>9</td>
</tr>
<tr>
<td>Auto Aid - Medical</td>
<td>121</td>
</tr>
<tr>
<td>Interfacility Transfer</td>
<td>2</td>
</tr>
<tr>
<td>Lift Assist</td>
<td>214</td>
</tr>
<tr>
<td>Medical</td>
<td>1,084</td>
</tr>
<tr>
<td>Medical - Alpha</td>
<td>1,173</td>
</tr>
<tr>
<td>Medical - Bravo</td>
<td>586</td>
</tr>
<tr>
<td>Medical - Charlie</td>
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</tr>
<tr>
<td>Medical - Delta</td>
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<tr>
<td>Medical - Echo</td>
<td>96</td>
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<tr>
<td>Medical - Psychiatric</td>
<td>121</td>
</tr>
<tr>
<td>Vehicle Accident</td>
<td>368</td>
</tr>
<tr>
<td>Vehicle Accident - Expanded</td>
<td>65</td>
</tr>
</tbody>
</table>

Total: 6,072
Sample Records
Sample records from the nine databases created for purposes of these analyses are presented in the following figures.

Figure 1. Sample Record from the AMR-CON Database.

<table>
<thead>
<tr>
<th>Run Number</th>
<th>Hour of Day</th>
<th>Hour of Year</th>
<th>Caller Code</th>
<th>Call Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,764,124</td>
<td>00:00</td>
<td>4366</td>
<td>FCFD</td>
<td>CONSOLIDATED FIRE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Address</th>
<th>ConFire Address Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>KIRKER PASS RD-PIT/ PITSBURG</td>
<td>KIRKER PASS RD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.98707500</td>
<td>-121.8974200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Patient Condition</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>029A</td>
<td>ALS-TRAFFIC ACCIDENTS</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response Type</th>
<th>Destination Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KAISER ANTIOCH HOSPITAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Priority Code</th>
<th>Unit</th>
<th>LOS</th>
<th>Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>ALS Life Threatening</td>
<td>6298</td>
<td>ALS</td>
</tr>
</tbody>
</table>

ConFire Vehicles Assigned

<table>
<thead>
<tr>
<th>Date</th>
<th>Latitude*</th>
<th>Longitude*</th>
<th>Master Incident ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/1/2012</td>
<td>37.982875</td>
<td>-121.886786</td>
<td>609,044</td>
</tr>
<tr>
<td>7/1/2012</td>
<td>37.98707500</td>
<td>-121.8974200</td>
<td></td>
</tr>
</tbody>
</table>

AMR CAD

<table>
<thead>
<tr>
<th>Time Call Received</th>
<th>Time Assigned</th>
<th>Time Enroute</th>
<th>Time OnScene</th>
<th>Time Depart</th>
<th>Arrived DestnTn</th>
<th>Time Call Cleared</th>
</tr>
</thead>
<tbody>
<tr>
<td>07/01/2012 00:16:57</td>
<td>07/01/2012 00:17:11</td>
<td>07/01/2012 00:17:26</td>
<td>07/01/2012 00:24:45</td>
<td>07/01/2012 00:42:06</td>
<td>07/01/2012 01:01:06</td>
<td>07/01/2012 01:27:19</td>
</tr>
</tbody>
</table>

AVL Intervals

<table>
<thead>
<tr>
<th>CAD Intervals</th>
<th>AVL Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConFire_Delay</td>
<td>00:01:07</td>
</tr>
<tr>
<td>Dispatch_Time</td>
<td>00:00:14</td>
</tr>
<tr>
<td>Chute_Time</td>
<td>00:00:15</td>
</tr>
<tr>
<td>Drive_Time</td>
<td>00:07:19</td>
</tr>
<tr>
<td>Response_Time</td>
<td>00:07:46</td>
</tr>
<tr>
<td>AtScene_Time</td>
<td>00:17:20</td>
</tr>
<tr>
<td>Transport_Time</td>
<td>00:19:01</td>
</tr>
<tr>
<td>InTake_Time</td>
<td>00:26:13</td>
</tr>
<tr>
<td>Time_on_Task</td>
<td>01:10:08</td>
</tr>
</tbody>
</table>
**Figure 2. Sample Record from the AMR-RMD Database.**

![Sample Record from the AMR-RMD Database](image)

---

**AMR CAD**

<table>
<thead>
<tr>
<th>Time</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Call Received</td>
<td>05/24/2012 11:52:57</td>
</tr>
<tr>
<td>Time Assigned</td>
<td>05/24/2012 11:53:13</td>
</tr>
<tr>
<td>Time Enroute</td>
<td>05/24/2012 11:53:51</td>
</tr>
<tr>
<td>Time Onscene</td>
<td>05/24/2012 12:02:51</td>
</tr>
<tr>
<td>Time Depart</td>
<td>05/24/2012 12:18:31</td>
</tr>
<tr>
<td>Time Arrived Destination</td>
<td>05/24/2012 12:40:25</td>
</tr>
<tr>
<td>Time Call Cleared</td>
<td>05/24/2012 13:08:05</td>
</tr>
</tbody>
</table>

**CAD Intervals**

<table>
<thead>
<tr>
<th>Interval</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSAP_Delay</td>
<td>0</td>
</tr>
<tr>
<td>Dispatch_Time</td>
<td>00:00:16 (1)</td>
</tr>
<tr>
<td>Chute_Time</td>
<td>00:00:38 (2)</td>
</tr>
<tr>
<td>Drive_Time</td>
<td>00:09:00 (3)</td>
</tr>
<tr>
<td>Response_Time</td>
<td>00:09:54 (4)</td>
</tr>
<tr>
<td>AtScene_Time</td>
<td>00:15:40 (5)</td>
</tr>
<tr>
<td>Transport_Time</td>
<td>00:21:55 (6)</td>
</tr>
<tr>
<td>InTake_Time</td>
<td>00:27:39 (7)</td>
</tr>
<tr>
<td>Time_on_Task</td>
<td>01:14:52 (8)</td>
</tr>
</tbody>
</table>

**Global_Index**

<table>
<thead>
<tr>
<th>Value</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>elapsed</td>
<td>01:14:52</td>
</tr>
<tr>
<td>elapsed</td>
<td>.4492</td>
</tr>
</tbody>
</table>
Figure 3. Sample Record from the CON Master Incidents Database
Figure 4. Sample Record from the CON Vehicles Assigned Database.

<table>
<thead>
<tr>
<th>Master_Incident_ID</th>
<th>Vehicle_Assigned_ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>E72,737</td>
<td>1,430,310</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ConFire_Function</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMS</td>
<td>37.941259</td>
<td>-121.954609</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Address</th>
<th>Jurisdiction</th>
<th>PriorityDesc</th>
<th>Radio_Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>5522 Pine Hollow Rd</td>
<td>C_CON Contra Costa Co (Centi)</td>
<td>P5-Non Emergency</td>
<td>E108</td>
</tr>
</tbody>
</table>

CAD Timestamps

| Time_Assigned | Time_Enroute | Time_ArrivedAtScene | Delayed_Availability | Time_Staged | TimeStatusChanged | Time_Call_Clear |
|---------------|--------------|---------------------|----------------------|-------------|------------------|-----------------
| 02/25/2013 08:02:00 | 02/25/2013 08:02:00 | 02/25/2013 08:05:00 | 02/25/2013 08:34:00 | 02/25/2013 08:34:00 | 02/25/2013 08:34:00 | 02/25/2013 08:34:00 |

CAD Intervals

<table>
<thead>
<tr>
<th>Enroute_2_Arrival</th>
<th>Assigned_2_Clear</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:03:00</td>
<td>00:31:51</td>
</tr>
</tbody>
</table>

AVL Timestamps

<table>
<thead>
<tr>
<th>AVL_PickUp</th>
<th>AVL_Assigned</th>
<th>AVL_EnRoute</th>
<th>AVL_Arrvd</th>
<th>AVL_Cleared</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/25/2013 08:01:33</td>
<td>02/25/2013 08:02:41</td>
<td>02/25/2013 08:02:48</td>
<td>02/25/2013 08:05:48</td>
<td>02/25/2013 08:34:32</td>
</tr>
</tbody>
</table>

AVL Intervals

<table>
<thead>
<tr>
<th>AVL-Chute</th>
<th>AVL-Drive</th>
<th>AVL-Crew</th>
<th>AVL_TotalRT</th>
<th>AVL_AtsCeno</th>
<th>AVL_T_on_T</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:07</td>
<td>00:03:00</td>
<td>00:03:07</td>
<td>00:04:15</td>
<td>00:28:44</td>
<td>00:31:51</td>
</tr>
</tbody>
</table>

Radio_Name | First | Assigned | Arrived |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AMRAD</td>
<td>02/25/2013 08:02:41</td>
<td>02/25/2013 08:02:41</td>
<td>02/25/2013 08:05:48</td>
</tr>
</tbody>
</table>

Global Index | Interval | Index_3 | Elapsed_mins | Elapsed |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>8</td>
<td>3</td>
<td>00:31:51</td>
<td>1911</td>
</tr>
</tbody>
</table>

Vehicles Arrived AtScene

<table>
<thead>
<tr>
<th>Amb</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

AVL_Arrived

<table>
<thead>
<tr>
<th>AMR_Assigned</th>
<th>AMR_Arrived</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/25/2013 08:33:29</td>
<td>02/25/2013 08:31:00</td>
</tr>
</tbody>
</table>

Con/First

Index

<table>
<thead>
<tr>
<th>Index_3</th>
<th>Elapsed</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>
Figure 5. Sample Record from the MOR Master Incidents Database.
Figure 6. Sample Record from the MOR Vehicles Assigned Database.

<table>
<thead>
<tr>
<th>Master_Incident_ID</th>
<th>Date</th>
<th>Master_Incident Flag</th>
<th>Hour_of_Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>651,477</td>
<td>12/08/2012</td>
<td>1</td>
<td>12:00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Priority_Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMS</td>
<td>P5-Non Emergency</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Call_Type_Description</th>
<th>IncidentTypeDesc</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMS-ALPHA Code Z with Engine</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Address</th>
<th>City</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>221 Alderbrook Pl</td>
<td>Moraga</td>
<td>37.843837000</td>
<td>-122.121361000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radio_Name</th>
<th>Origin</th>
<th>Veh Arvd</th>
<th>MFR FirstArvd</th>
<th>MED FirstArvd</th>
</tr>
</thead>
<tbody>
<tr>
<td>M141</td>
<td>MOR</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AVL_PickUp</th>
<th>AVL_Assigned</th>
<th>AVL_EnRoute</th>
<th>AVL_Arrv</th>
<th>EnRouteFacilityDateTime</th>
<th>ArrivedFacilityDateTime</th>
<th>AVL_Cleared</th>
<th>MFR DispatchDateTime</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Unit</th>
<th>AVL_Assigned</th>
<th>Dispatch_Time</th>
<th>Assigned_Delay</th>
<th>Chute_Time</th>
<th>Drive_Time</th>
<th>Crew_Time</th>
<th>Response_Time</th>
<th>AtScene_Time</th>
<th>Transport_Time</th>
<th>InTake_Time</th>
<th>Time_on_Task</th>
<th>Elapsed_min</th>
<th>Elapsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>E141</td>
<td>12/08/2012 12:09:58</td>
<td>06:01:24 0</td>
<td>00:00:00 1</td>
<td>00:00:17 2</td>
<td>00:06:01 3</td>
<td>00:06:18 4</td>
<td>00:07:42 5</td>
<td>00:16:14 6</td>
<td>00:19:30 7</td>
<td>00:34:20 8</td>
<td>01:15:22 9</td>
<td>01:16:22</td>
<td>45:52</td>
</tr>
</tbody>
</table>

Index
Figure 7. Sample Record from the RMD Master Incidents Database.

![Richmond Master Incidents](image)

<table>
<thead>
<tr>
<th>objectID</th>
<th>PRIMARYKEY</th>
<th>INC_NUM</th>
<th>CFS_NUM</th>
<th>CFS_ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>708,572</td>
<td>2012-00009853.817</td>
<td>2012-00009853</td>
<td>817</td>
<td>4,057,036</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVADDRESS</td>
<td>128 S 15TH ST</td>
<td>Richmond</td>
<td>128 S 15TH ST</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESPONSE</td>
<td>-178</td>
<td>MEDIC</td>
<td>-48</td>
<td>-2</td>
</tr>
<tr>
<td></td>
<td>AMR Verified for response</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**AMR Vehicles Assigned**

<table>
<thead>
<tr>
<th>RMD INCIDENT ID</th>
<th>UNIT</th>
<th>LATITUDE</th>
<th>LONGITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>708,572</td>
<td>178</td>
<td>37.93038332</td>
<td>-122.35500861</td>
</tr>
<tr>
<td>8,792,423</td>
<td>6219</td>
<td>37.93077100</td>
<td>-122.35492600</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CREATE_DATE</th>
<th>DISP_DATE</th>
<th>ARRV_DATE</th>
<th>SPLIT DTM</th>
<th>DATE_CLOSE</th>
<th>RESP_TIME</th>
<th>RESP_TIME2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-10-01 01:14:01</td>
<td>2012-10-01 01:15:53</td>
<td>2012-10-01 01:20:52</td>
<td>2012-10-01 01:21:01</td>
<td>2012-10-01 01:28:11</td>
<td>4.98</td>
<td>5.00</td>
</tr>
<tr>
<td>ClockStart</td>
<td>Assigned_TS</td>
<td>Arrvd_TS</td>
<td>Split_TS</td>
<td>Close_TS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dispatch_Time**

- 00:01:52
- 00:01:54
- 00:04:59
- 00:06:51
- 00:13:18
- 00:01:48

**Time on Task**

- elapsed: 108

**index**

- 0
- 1
- 2
- 3
- 4
- 5
Figure 8. Sample Record from the SRV Master Incidents Database.
**APPENDIX 1**

Figure 9. Sample Record from the CON Master Incidents Database.

![Sample Record from the CON Master Incidents Database](image)

**San Ramon Valley Vehicles Assigned**

<table>
<thead>
<tr>
<th>Master_Incident_ID</th>
<th>Date</th>
<th>Master_Incident_Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,000,113</td>
<td>01/07/2012</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IncidentNumber_Fire_Medical</th>
<th>CallType</th>
<th>Medical_Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>113</td>
<td>VA</td>
<td>Vehicle Accident</td>
</tr>
</tbody>
</table>

**Call_Type_Description**

Vehicle Accident

**IncidentTypeDesc**

322 - Motor vehicle accident with injuries

**Location**

X1:STONE VALLEY RD, X2:ROUNDHILL DR

**City**

ALAMO

**Latitude**

37.849925829

**Longitude**

-122.003749472

**Hour_of_Day**

16:00:00

**UnitID**

RM32

**UnitType**

Rescue Medic

<table>
<thead>
<tr>
<th>Yeh_Arrv</th>
<th>MFR_FirstArrv</th>
<th>PM &amp; RM_FirstArrv</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CallReceivedDateTime**

01/07/2012 16:22:29

**DispatchDateTime**

01/07/2012 16:22:48

**EnRouteDateTime**

01/07/2012 16:24:54

**ArrivalDateTime**

01/07/2012 16:26:02

**EnRouteFacilityDateTime**

01/07/2012 16:35:13

**ArrivedFacilityDateTime**

01/07/2012 16:35:17

**ClearDateTime**

01/07/2012 17:12:11

**Unit**

DispatchDateTime

<table>
<thead>
<tr>
<th>Dispatch_Time</th>
<th>Assigned_Delay</th>
<th>Chute_Time</th>
<th>Drive_Time</th>
<th>Crew_Time</th>
<th>Response_Time</th>
<th>AtScene_Time</th>
<th>Transport_Time</th>
<th>InTake_Time</th>
<th>Time_on_Task</th>
<th>Global_Index</th>
<th>Index</th>
<th>Elapsed_mmss</th>
<th>Elapsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:19</td>
<td>00:00:01</td>
<td>00:02:06</td>
<td>00:01:08</td>
<td>00:03:14</td>
<td>00:03:33</td>
<td>00:09:11</td>
<td>00:00:04</td>
<td>00:36:54</td>
<td>00:49:23</td>
<td>7</td>
<td>7</td>
<td>00:00:04</td>
<td>4</td>
</tr>
</tbody>
</table>

**SRV DispatchDateTime**

01/07/2012 16:22:47

**Portal_2_SRV_FirstArrv**

<table>
<thead>
<tr>
<th>Dispatch_Time</th>
<th>Assigned_Delay</th>
<th>Chute_Time</th>
<th>Drive_Time</th>
<th>Crew_Time</th>
<th>Response_Time</th>
<th>AtScene_Time</th>
<th>Transport_Time</th>
<th>InTake_Time</th>
<th>Time_on_Task</th>
<th>Global_Index</th>
<th>Index</th>
<th>Elapsed_mmss</th>
<th>Elapsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:19</td>
<td>00:00:01</td>
<td>00:02:06</td>
<td>00:01:08</td>
<td>00:03:14</td>
<td>00:03:33</td>
<td>00:09:11</td>
<td>00:00:04</td>
<td>00:36:54</td>
<td>00:49:23</td>
<td>7</td>
<td>7</td>
<td>00:00:04</td>
<td>4</td>
</tr>
</tbody>
</table>

**MFR FirstArrv**

<table>
<thead>
<tr>
<th>Dispatch_Time</th>
<th>Assigned_Delay</th>
<th>Chute_Time</th>
<th>Drive_Time</th>
<th>Crew_Time</th>
<th>Response_Time</th>
<th>AtScene_Time</th>
<th>Transport_Time</th>
<th>InTake_Time</th>
<th>Time_on_Task</th>
<th>Global_Index</th>
<th>Index</th>
<th>Elapsed_mmss</th>
<th>Elapsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:19</td>
<td>00:00:01</td>
<td>00:02:06</td>
<td>00:01:08</td>
<td>00:03:14</td>
<td>00:03:33</td>
<td>00:09:11</td>
<td>00:00:04</td>
<td>00:36:54</td>
<td>00:49:23</td>
<td>7</td>
<td>7</td>
<td>00:00:04</td>
<td>4</td>
</tr>
</tbody>
</table>

**PM & RM FirstArrv**

<table>
<thead>
<tr>
<th>Dispatch_Time</th>
<th>Assigned_Delay</th>
<th>Chute_Time</th>
<th>Drive_Time</th>
<th>Crew_Time</th>
<th>Response_Time</th>
<th>AtScene_Time</th>
<th>Transport_Time</th>
<th>InTake_Time</th>
<th>Time_on_Task</th>
<th>Global_Index</th>
<th>Index</th>
<th>Elapsed_mmss</th>
<th>Elapsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:19</td>
<td>00:00:01</td>
<td>00:02:06</td>
<td>00:01:08</td>
<td>00:03:14</td>
<td>00:03:33</td>
<td>00:09:11</td>
<td>00:00:04</td>
<td>00:36:54</td>
<td>00:49:23</td>
<td>7</td>
<td>7</td>
<td>00:00:04</td>
<td>4</td>
</tr>
</tbody>
</table>