Evaluation of the Use of EMS Quality Improvement Measures in California, 2012-2015

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A Report Prepared for the California Emergency Medical Services Authority

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Executive Summary

In 2012, the California Emergency Medical Services Authority (EMSA) embarked upon an ambitious initiative to routinely collect and analyze statewide EMS performance data that could be used for quality improvement purposes. More specifically, the EMSA's EMS Core Measures Project sought to increase "*the accessibility and accuracy of pre-hospital data for public policy, academic and research purposes to facilitate EMS system evaluation and improvement."* [1]

A set of 17 evidence-based EMS performance measures was selected to serve as the Project's Core Measure Set. These were derived largely from a set of quality indicators identified by the National Quality Forum and were selected *"to benchmark the performance of EMS systems, perform recommended treatments determined to get the best results for patients with certain medical conditions, and transport of patients to the most appropriate hospital."* [1] The original core measure set has remained unchanged to date.

California's 33 local EMS agencies (LEMSAs) collect the EMS Core Measure data from the EMS providers in their service areas and then report the locally aggregated data to the EMSA, where the data are incorporated into the statewide EMS Core Measures Project database. Reporting of data by LEMSAs has improved since 2012, and all LEMSAs are now contributing data to the EMS Core Measures Project. However, significant variability still exists in the number of LEMSAs reporting on each measure and among the results that are reported. The reasons for these differences are unclear. Some of these variations may represent true differences in outcomes and processes of clinical importance to patients, while others may be due to data collection and management issues. Determining the reasons for these differences was beyond the scope of this project.

As part of a point-in-time assessment of the EMS Core Measures Project, the EMSA contracted with the UC Davis Institute for Population Health Improvement (IPHI) to independently review the first four years of Core Measure Project reported data and the Project's implementation. The IPHI was specifically asked to: [2]

1. "Review the EMS Authority-provided Core Measures data collection process map of how the data is obtained, managed or processed, and analyzed to derive reported results. This process map will delineate all material steps from on-site raw data generation to submission of core measure results." This deliverable was later supplanted by conducting a survey of local EMS agencies about their data management processes and other issues related to use of the Core Measures.

[1] http://www.emsa.ca.gov/ems_core_quality_measures_project

[2] UC Davis-Institute for Population Health Improvement Contract #C15-039, Emergency Medical Services (EMS) Core Measures Project

2. "Review the EMS Authority core measures reports."

3. "Conduct an independent analysis of EMSA Core Measure data collected to date, drawing conclusions, and identifying their limitations, about any statistically significant differences over time within and across Local EMS Agencies (LEMSA)." The EMSA Core Measures Reports for data years 2012, 2013, 2014 and 2015, were reviewed and analyzed. In light of numerous unanswered questions about how the performance measure data were collected, collated and processed by the LEMSAs and their local EMS providers, and especially about how standardized and consistent were the approaches to data management at the local level and over time, we concluded that statistical analysis of the aggregated statewide data might produce misleading or erroneous conclusions and limited our analysis to a qualitative assessment of year-to-year differences.

4. "Conduct a targeted literature review of the state-of-the-art of EMS performance measurement."

5. "Produce a summary report that includes:

a. **Analysis of Core Measure data collection process map;**

b. **Analysis of reported Core Measure data;**

c. **Narrative summary of the site visits and interviews, if applicable;"** (In concert with EMSA, it was decided not to conduct any site visits or interviews and rely upon the results of the LEMSA survey instead.)

d. **"Discussion of perceived limitations of data reporting and interpretations, based on findings and site visits/interviews; if applicable;**

e. **Recommendations for improving the core measures and data management, incorporating knowledge and lessons gained from Quality Improvement (QI) assessments conducted in other topical areas."**

To gain a better understanding of local EMS Core Measure Project data management processes and issues affecting Core Measure Project implementation and utilization, the IPHI project team surveyed the LEMSAs. Thirty-one of the 33 LEMSAs (94%) completed the survey. For the survey analysis, LEMSAs were categorized according to self-reported 911 system call volume as Large (>100,000 calls per year), Medium (25,000 to 100,000 calls per year), or Small (<25,000 calls per year). Based on the call volumes reported in the survey forms, there were 11 Large, 7 Medium and 13 Small LEMSAs among the respondents.

As would be expected in launching a complex initiative such as this in a state as large and diverse as California, there have been variable levels of local "buy in" and enthusiasm for the Project, and the effort has not always moved forward as rapidly as some may have initially hoped. Overall, though, we applaud the EMSA's leadership for undertaking this challenging effort and commend the EMS Core Measures Project for what it has accomplished to date. Much has been done.

Based on the results of our survey of LEMSAs, our review of the annual EMSA Core Measures Project reports, the review of the literature, and the IPHI project team's collective expertise, we make the following broad observations and findings.

1. The highly diverse nature of California's LEMSAs and the multiple EMS providers that are typically found within the LEMSAs (in many cases more than 10) create significant challenges in collecting and aggregating reliable and timely data for the core measures. These challenges should be able to be substantially mitigated through increased training of EMS personnel about data management, use of standardized prehospital electronic health record (EHR) systems, and enhanced LEMSA data systems.

2. In implementing the Core Measures Project, EMSA's role in facilitating and nurturing quality improvement activities appears not to always have been clear to the LEMSAs and EMS providers. In noting this, we recognize that the EMSA has conducted multiple workshops aimed at promoting understanding of the Core Measures Project and encouraging LEMSAs to use these standardized measures for quality improvement purposes. We are also mindful that regulated communities often have a variety of uncertainties, concerns and fears when regulatory agencies try to lead quality improvement efforts because of the difference in mindsets and approaches, among other things, used when enforcing regulatory compliance and leading quality improvement initiatives. To address these issues, many regulatory agencies partner with or utilize a non-regulatory organization to conduct quality improvement activities.

3. Most LEMSAs devote few resources to data collection and analysis. Determining the reasons for this was beyond the scope of this project, although we were able to determine that the amount of resources devoted to data management does not necessarily correlate with the size of the LEMSA (in contrast to LEMSA participation in various condition-specific registries where large LEMSAs are more likely to participate in multiple registries).

4. Most LEMSAs report that the lack of accurate reporting from EMS providers and that software and core measure definition challenges are the biggest problems in implementing the Core Measures Project. A large majority of LEMSAs reported that

measures which require hospital outcome data are the most difficult ones for which to obtain data.

5. Most LEMSAs report that they do not regularly use the Core Measures Project data for quality improvement purposes. Nearly a third of LEMSAs report that they do not use these data for any purpose other than reporting them to the EMSA. Determining the reasons for this was beyond the scope of this survey, but we find the reported lack of use of these data for their intended purpose to be of concern.

6. A majority of the LEMSAs opined that fewer and more clearly defined and easily captured measures would have been helpful during the initial Project roll out. Of note, we made no assessment of the EMS performance measures selected for use in the Project, nor did we assess how much of an issue the number of core measures which must be reported upon continues to be viewed as problematic; analyzing these things were beyond the scope of this project.

7. Given the variable nature of the reported data in the 2012-2015 Core Measure Project summaries, the use of descriptive statistics would be of unlikely value and was not done in this report. Indeed, statistical analysis of these data could lead to misleading or erroneous conclusions. Without a specific hypothesis about expected performance and level of clinical significance, we believe statistical comparison is not indicated.

RECOMMENDATIONS

Going forward, we believe that the EMSA should build upon the solid foundation it has developed so far, focusing especially on the following four broad areas:

(1) Find ways to leverage its role as a regulatory agency to stimulate and nurture use of EMS core measure data for quality improvement purposes. Increasing the number of quality improvement training opportunities may be helpful in this regard. We believe the EMSA should partner with a non-regulatory organization that is experienced in providing education and training to develop and offer quality improvement and other relevant training through use of face-to-face and virtual modalities. It should consider encouraging or facilitating increased training offerings for EMS providers, as well as LEMSAs, which might lead to certification opportunities or other recognitions and awards. The EMSA should routinely review the required LEMSA quality improvement plans for Core Measure-relevant activities and assurance that these elements of the plans are being implemented.

(2) Find ways to normalize and integrate use of EMS core measure data into local quality management activities. It should consider how use of real-time performance "dashboards" might be helpful in this regard. While promoting use of the EMS core measure data for quality improvement purposes should be a shared LEMSA leadership responsibility, in most cases the LEMSA medical director should take the lead in this regard. The LEMSA medical director should have clearly defined roles and responsibilities for doing so in the LEMSA quality improvement plan. The EMSA should provide guidance and support to the LEMSAs and LEMSA medical directors in this regard so that the medical directors are prepared to lead quality improvement strategies and promote best practices across the LEMSAs.

(3) Standardize, streamline and support data collection and processing across local EMS providers and LEMSAs. These efforts should continue to emphasize the critical roles of paramedics and EMTs in collecting data elements that can be used to improve their performance. The recent statutory requirement for the use of standardized national EMS information system data elements and real-time data collection in the field through use of an electronic health record may improve the quality and timeliness of data collection and substantially address current concerns in this regard. We recommend that the degree of standardization of data collection and processing across the LEMSAs be formally evaluated after these changes have been materially implemented.

(4) Work with hospital organizations and other relevant groups to facilitate health information exchange between hospitals and EMS providers and LEMSAs. This is especially important to quality improvement efforts in so far as it allows hospital diagnosis and outcome data to be compared with pre-hospital impressions, which will help in the assessment of the utility of individual core measures.

More specifically, we further recommend that the EMSA:

- Consider how it might incentivize LEMSAs and EMS providers, using a variety of recognitions and awards, to utilize the EMS Core Measures data for quality improvement purposes.

- Working with the LEMSAs, continue to develop and refine standardized methods for the collection, aggregation and processing of EMS core measures data by EMS providers and LEMSAs, along with methods to audit compliance with these standardized methods. The EMSA, or its designated representative for quality improvement activities, should promote understanding and use of these standardized data management methods through seminars and conferences, webinars, use of learning aids (e.g., a web-based learning modules), and other methods. Toward this end, the EMSA should develop a standardized Core Measures data collection process map that details how the data

should be obtained, managed or processed, and analyzed to derive reported results. This process map should delineate all material steps from on-site raw data generation to submission of core measure results.

- Evaluate whether the Core Measure Task Force should be continued, expanded or otherwise modified to ensure that it provides an effective vehicle for reviewing the EMS Core Measure Set. In particular, the Task Force should be assessed with regard to whether it includes broad participation from end-users, has sufficient transparency about performance measure criteria and review processes, and is utilizing appropriate methods for adding and retiring individual performance measures. In addition, the EMSA should consider whether the number of core measures reported upon optimizes their value to the LEMSAs and how well the measures are aligned with new national performance measures.

- Consider retiring core measures that have met predefined expected performance levels and develop a process to rotate or introduce new measures into the Core Measures Set. In this regard, we suggest that particular attention be directed to increasing the proportion of outcome measures. We believe a process for retiring and adding measures would facilitate use of core measures to achieve desired practice patterns, and - once goals have been achieved - allow the EMSA to focus on new improvement areas. We recognize that maturation of local or regional health information exchanges and implementation of the new NEMSIS data standards may facilitate this process. This issue should be reassessed after the NEMSIS data standards have been implemented.

Chapter 1. Background and Statement of Task

Introduction

Performance measurement has become increasingly common across all types of medical care services in recent years concomitant with the now well recognized need to improve the quality and value of health care. Pre-hospital emergency medical services (EMS) are no exception. Over the past 15 years, and especially since the 2006 Institute of Medicine report *Emergency Medical Services at the Crossroads*,[3] use of performance measures in EMS has been actively discussed and increasingly accepted as an integral part of pre-hospital care, although the use of EMS performance measures remains far from routine.

Recognizing the importance of using performance measures to improve the quality of EMS services, the California Emergency Medical Services Authority (EMSA) embarked upon an ambitious statewide EMS performance measurement initiative in 2012. A committee of subject matter experts was convened to select a core set of evidence-based EMS performance measures. The committee selected 17 measures (the "EMS Core Measures") from amongst an array of candidate measures identified by the National Quality Forum and others.[4,5,6,7] The EMSA began collecting data on these core measures in 2012, and has produced annual reports since that time.[8,9,10] The core measure data are reported to EMSA by California's 33 local emergency medical services agencies (LEMSAs), who collect data from their local EMS providers. The local EMS providers use various software programs and other methods to

[3] Institute of Medicine. *Emergency Medical Services at the Crossroads*. Washington, DC. National Academies Press. 2006.
[4] Williams J, Mears G, Brice J, Raisor C, Cairns C. *National Quality Forum Environmental Scan: Regionalized Emergency Medical Care Services*. EMS Performance Improvement Center, University of North Carolina at Chapel Hill. 2011.
[5] National Highway Traffic Safety Administration. *Emergency Medical Services Performance Measures – Recommended Attributes and Indicators for System and Service Performance*. Washington, DC. U.S. Department of Transportation. 2009.
[6] http://www.nemsis.org/referenceMaterials/performanceMeasures.html
[7] National EMS Management Association and HealthAnalytics. *EMS Core Measures: Suggestions For Consideration by the National EMS Performance Measures Project*. Presented at the EMS Performance Measures Project Meeting; Arlington, VA. September 21, 2004.
[8] Emergency Medical Services Authority. *EMS Core Measures Project. Reporting Capability of EMSA and LEMSA Data Systems and Results from Clinical Measures Reports Data Years 2012-2013*. Sacramento, CA. June 2014.
[9] Emergency Medical Services Authority. *EMS Core Measures Project. Reporting Capability of EMSA and LEMSA Data Systems and Results from Performance Measures Data Year 2014 With Comparison to Years 2012 and 2013*. Sacramento, CA. October 2015.
[10] Emergency Medical Services Authority. *EMS Core Measures Project. Reporting Capability of EMSA and LEMSA Data Systems and Results from Performance Measures Data Year 2015 With Comparison to Years 2012, 2013 and 2014*. Sacramento, CA. June 2016.

aggregate their individual run report data to pass along to the LEMSAs. The number of LEMSAs reporting data and the number of core measures reported upon by the LEMSAs to the EMSA has increased each year. Of note, California was the first state to establish a standardized set of performance measures to be used statewide to evaluate EMS system performance.[11]

To provide background and context for the findings and recommendation made in this report, this chapter provides a brief history of EMS systems development in California, a description of EMSA's EMS Core Measures Project, and a statement of the deliverables asked for as part of the Institute for Population Health Improvement's EMS Core Measures Project.[12]

A Short History of Emergency Medical Services in California

Emergency Medical Services (EMS) systems began to evolve in California in the late 1960s as awareness grew of the alarmingly high number of out-of-hospital deaths from trauma and cardiac arrest.[13] A pilot project using mobile intensive care paramedics was launched in Los Angeles County in 1970. The Wedworth-Townsend Paramedic Act defining the role and scope of practice of mobile intensive care paramedics and nurses was enacted in 1970, making California the first state to adopt legislation permitting advanced medical life support to be provided in the pre-hospital setting by EMS personnel.[14] The LA County paramedic pilot program was expanded in 1972, and other California counties soon began to develop EMS programs.

Responsibility for overseeing and coordinating local (county) EMS systems in the state was initially assigned to the EMS Section of the then California Department of Health Services (DHS). However, the DHS did not place a high priority on EMS and found itself increasingly at odds with the state's rapidly growing EMS community. DHS abolished its EMS Section in 1979, creating considerable disharmony in the EMS community and resulting in counties becoming the focal point of EMS systems development. This led to enactment of legislation in 1980 that created a new stand-alone EMS Authority within the then California Health and Welfare Agency.[15] The new Emergency Medical Services Authority (EMSA) was charged with being the lead state agency for pre-hospital emergency and disaster medical services, while DHS retained

[11] McCallion T. Establishing EMS Performance Measures. California is setting the standard. *JEMS*. August 26, 2013.
[12] UC Davis-IPHI contract #C15-039, Emergency Medical Systems (EMS) Core Measures Project, Emergency Medical Services Authority.
[13] Committee on Trauma and Committee on Shock. *Accidental Death and Disability: The Neglected Disease of Modern Society*. Washington, DC. National Academy of Sciences-National Research Council. 1966.
[14] California Health & Safety Code, Article 3, Sections 1480–85. Wedworth-Townsend Paramedic Act of 1970.
[15] California Health & Safety Code, Chapter 2.5, Sections 1797 et seq. Garamendi-Torres EMS System Act of 1980.

responsibility for hospital and many other aspects of emergency and disaster public health and medical response.

State regulations establishing training and other standards for paramedics were promulgated by the EMSA in 1983. These were followed in 1984 by statewide guidelines for local EMS systems,[16] standards for local trauma care systems, and training standards for other EMS providers. These standards and guidelines have been incrementally revised and updated over the years, but the regulatory framework established in the early 1980s has remained the basic foundation for the state's EMS system.

EMS activities in California are regulated at the state level by the EMSA pursuant to Division 2.5, California Health and Safety Code, and Division 9, Title 22, California Code of Regulations. Today, the EMSA is one of 13 departments overseen by the California Health and Human Services Agency. Day-to-day EMS activities are governed by local EMS agencies (LEMSAs), which follow state regulations and standards established by the EMSA. Currently, there are 26 single-county and 7 multicounty LEMSAs in California (see figure 1).[17]

The EMSA is statutorily authorized to develop and implement regulations governing the medical training and scope of practice for emergency medical care personnel, including paramedics and emergency medical technicians (EMTs) and public safety personnel (e.g., firefighters, law enforcement officers, lifeguards), among others. EMS personnel are trained according to state standards and then licensed (paramedics) or certified (basic and advanced EMTs) to render emergency medical care in pre- and inter-hospital settings. All ambulance attendants are required by California law to be trained and certified to the EMT level (basic life support, or BLS), and many fire agencies require firefighters to be EMT certified since they are often the first responders to an incident even though the fire service often does not provide patient transportation.

There are three levels of EMTs in California: Basic (EMT), Advanced (EMT-A), and Paramedic (EMT-P). Paramedics are trained and licensed in advanced life support skills, including endotracheal intubation and selected other invasive procedures, as well as the intravenous and intramuscular administration of medications. They are typically employed by public safety agencies (e.g., fire departments) or private ambulance companies. Requirements for EMT and paramedic initial training and continuing education are available on the EMSA website.[17]

[16] Kizer KW, Moorhead GV, McNeil M. *Emergency Medical Services Systems Standards and Guidelines*. Sacramento, CA. Emergency Medical Services Authority.1984.
[17] http://www.emsa.ca.gov

Services provided by EMTs and paramedics are done so under medical control through pre-established, locally approved medical policies and protocols and through direct linkage to locally designated hospital emergency departments (base hospitals). These services are typically initiated by a telephone call to 911 or other designated emergency telephone number.

Paramedics became a statewide licensed health care practitioner in California in 1994. Licenses are issued by the EMSA and are valid statewide, but paramedics must be accredited by a local EMS agency before practicing. Licensure by the EMSA must be renewed every two years. In contrast, EMTs and EMT-As are certified by local EMS agencies; they must recertify every two years. EMT certifications are valid statewide, but EMTs can only work in areas after they are certified by a local EMS agency.

EMS Core Measures Project

The California EMSA implemented the EMS Core Measures Project in 2012 in an effort to standardize reporting of clinically important EMS process and outcome data.[18] More recently, as part of a point-in-time assessment of the initiative, EMSA contracted with the UC Davis Institute for Population Health Improvement (IPHI) to independently review the first four years of Core Measures reported data and project implementation.

The EMS Core Measures Initiative was undertaken by the EMSA primarily for the purpose of increasing "*the accessibility and accuracy of pre-hospital data for public policy, academic and research purposes to facilitate EMS system evaluation and improvement. The preliminary core measures were derived largely from a set of quality indicators developed through a project by the National Quality Forum.*[19] *The core measures data will begin to benchmark the performance of EMS systems, perform recommended treatments determined to get the best results for patients with certain medical conditions, and transport of patients to the most appropriate hospital. Information about these treatments are taken from the pre-hospital care reports and converted into a percentage. The measures are based on scientific evidence about processes and treatments that are known to get the best results for a condition or illness. Core Measures help emergency medical services systems improve the quality of patient care by focusing on the actual results of care.*" [20]

[18] Emergency Medical Services Authority, *California EMS Systems Core Quality Measures*; Sacramento, CA. 2013.
[19] Williams J, Mears G, Brice J, Raisor C, Cairns C. *National Quality Forum Environmental Scan: Regionalized Emergency Medical Care Services*. EMS Performance Improvement Center, University of North Carolina at Chapel Hill. 2011.
[20] http://www.emsa.ca.gov/ems_core_quality_measures_project

Statement of Task

The IPHI EMS Core Measures Project was undertaken to provide an independent, objective assessment of EMSA's EMS Core Measures Project. In doing this, the IPHI was specifically asked to: [21]

1. "Review the EMS Authority-provided core measures data collection process map of how the data is obtained, managed or processed, and analyzed to derive reported results. This process map will delineate all material steps from on-site raw data generation to submission of core measure results."

After the inter-agency agreement was actualized, this deliverable was, by mutual agreement, supplanted by conducting a survey of local EMS agencies about their processes and other issues related to core measures. The results of this survey are presented in Chapter 2 and Appendix B.

2. "Review the EMS Authority core measures reports."

3. "Conduct an independent analysis of EMSA core measure data collected to date, drawing conclusions, and identifying their limitations, about any statistically significant differences over time within and across Local EMS Agencies (LEMSA)."

EMSA Core Measures Reports were reviewed for 2012, 2013, 2014 and 2015, and provided the basis for the analysis detailed in Chapter 3. In light of multiple unanswered questions about how the performance measure data were collected, collated and processed by the LEMSAs and their local ALS providers, and especially how standardized and consistent, or not, were the approaches to data management at the local level and over time, we believe that statistical analysis of the aggregated statewide data might produce misleading or erroneous conclusions. Therefore, our assessment of year to year differences was largely qualitative.

4. "Conduct a targeted literature review of the state-of-the-art of EMS performance measurement."

A review of the professional literature about the use of EMS performance measures is presented in Chapter 4.

5. "Produce a summary report that includes:

f. Analysis of core measure data collection process map;

g. Analysis of reported core measure data;

[21] UC Davis-IPHI contract #C15-039, Emergency Medical Systems (EMS) Core Measures Project, Emergency Medical Services Authority.

h. Narrative summary of the site visits and interviews, if applicable;"

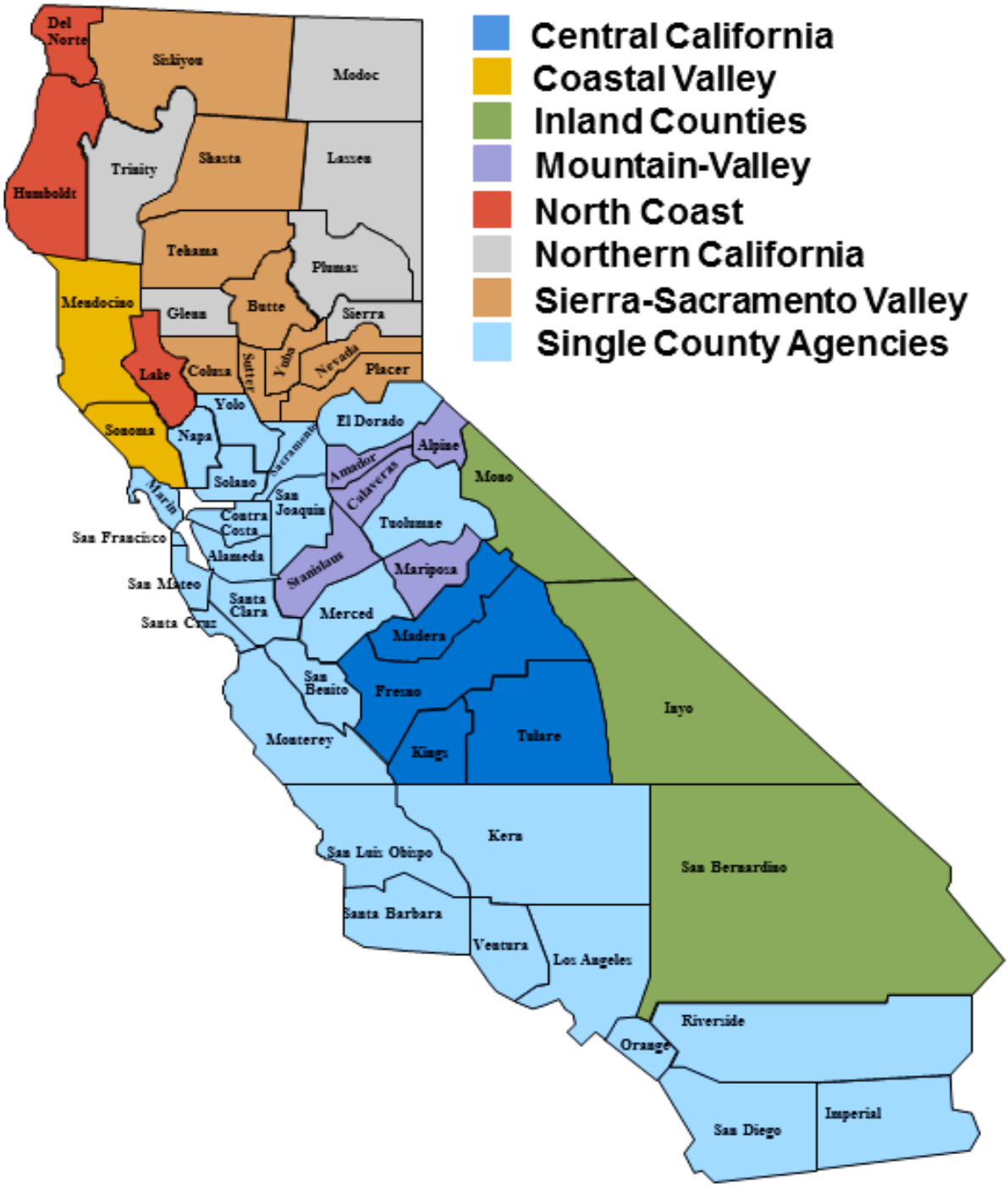
In concert with EMSA, it was decided not to conduct any site visits or interviews. The above noted survey of the LEMSAs was conducted instead.

i. "Discussion of perceived limitations of data reporting and interpretations, based on findings and site visits/interviews; if applicable;

j. Recommendations for improving the core measures and data management, incorporating knowledge and lessons gained from Quality Improvement (QI) assessments conducted in other topical areas."

This report presents a summary of our findings and impressions.

Figure 1.1. California's Local EMS Agencies (single and multi-county)



Chapter 2. Summary of Local EMS Agency Survey Regarding Core Measures

Introduction

The EMSA implemented the Core Measures Project in 2012 in an effort to standardize the reporting of clinically important EMS process and outcome data, with the goal of tracking performance and providing a benchmark for ongoing quality improvement efforts. As part of the assessment of the Core Measures Project implementation, the EMSA contracted with the UC Davis Institute for Population Health Improvement (IPHI) to independently review the Core Measures Project.

Each LEMSA is responsible for reporting its core measures data to the EMSA for incorporation into the statewide Core Measures Project database. Although the number of LEMSAs reporting has increased since 2012, considerable variability still exists on the number of measures reported upon by the LEMSAs. In addition, substantial variability exists among LEMSAs with regard to the results that are reported. The reasons for these differences are unclear. Some of these differences may represent true differences in outcomes and processes of clinical importance to patients, but it is also possible that data reporting and management issues underlie at least some, or even much, of the differences in reported results. To better understand the reasons for the variability, as well as to help characterize the challenges and opportunities LEMSAs face in reporting core measures, the UC Davis IPHI project team surveyed the LEMSAs to gain a better understanding of local core measure data management processes and issues affecting core measure implementation and utilization.

Methods

A 14-question survey was developed and sent to each of the 33 LEMSAs. The survey sought to better understand local issues that affected core measure data reporting. We developed the survey instrument in concert with the EMSA staff using Qualtrics Research software available through UC Davis. Survey questions were targeted to assess how core measures data are obtained and analyzed by the LEMSAs.

Surveys were sent to the executive directors of each of the 33 LEMSAs. Follow up e-mail contact was made for those that did not respond within two weeks. A third and fourth follow up attempt was subsequently made through directed phone contact for LEMSAs that had not yet responded.

Results

Thirty-two (96%) LEMSAs responded to the survey. One survey was only minimally completed, leaving 31 completed surveys (94%). [Of note, one of these 31 surveys was largely completed but omitted answers to four questions. Answers to the questions which were responded to were included in the survey analysis, resulting in there being either 31 or 30 respondents for individual questions.] The survey instrument and question-by-question responses are detailed in Appendices A and B.

For the survey analysis, LEMSAs were categorized according to self-reported 911 system call volume as Large (>100,000 calls per year), Medium (25,000 to 100,000 calls per year), and Small (<25,000 calls per year). The number of counties served and number of advanced life support (ALS) units within a given LEMSA were also used to subgroup the LEMSAs. This categorization was based on the hypothesis that larger LEMSAs would have more staff and resources dedicated to implementing the Core Measures Project, and would likely have better data reporting and validity.

Based upon the call volumes reported in the returned surveys, there were 11 Large, 7 Medium and 13 Small LEMSAs among the 31 responding LEMSAs. One LEMSA (Los Angeles County) was substantially larger than the others in the Large LEMSA grouping, having a call volume exceeding 500,000 per year.

Twenty-four (77%) LEMSAs covered a single county. Twenty-seven (87%) LEMSAs contract with more than one advanced life support (ALS) EMS provider for 911 system responses. The majority of large LEMSAs contract with 10 or more ALS providers.

The following is a summary of the pertinent responses to each survey question:

Question 6: ***"Does your LEMSA have a dedicated Quality Improvement analyst/data analyst who creates and runs reports from EMS providers?"***

Twenty of 31 (65%) LEMSAs described having "no FTE"[22] or "less than 1 FTE" devoted to data management and analysis. Four (36%) of the large LEMSAs reported having "less than 1 FTE" for data management and analysis.

Question 7: ***"For Core Measures your LEMSA has difficulty reporting, what are the most common reasons for the difficulty?"***

[22] FTE = full time employee

Seventeen of 31 (55%) LEMSAs reported that EMS providers are not providing the data to them. Other reported difficulties included "lack of clear definitions," "staffing," and "no hospital outcome data available." These data highlight the challenges LEMSAs face in reporting data that comes from multiple providers.

Question 8: ***"Over the past 3 years, what have been the greatest logistical challenges faced in implementing Core Measures?"***

Fourteen of 31 (45%) LEMSAs reported "challenges getting complete core measure data from EMS providers," while 16 (52%) reported "software/definition dictionary compatibility issues." LEMSAs commented that they struggle with some 911 providers not supplying complete data for core measures. (We understand that some EMS providers still use paper records or provide details in a narrative section of the prehospital care report that cannot be easily automated.) Lack of staffing was listed by 45% (14/31) of LEMSAs and lack of financial resources was indicated by 29% of LEMSAs (9/31). These resource limitations were reported primarily by the small LEMSAs, although more than a third of the large LEMSAs had less than 1.0 FTE devoted to data management and analysis, but this did not seem to be a perceived barrier to those LEMSAs.

Question 9: ***"How often does your LEMSA review the Core Measure data?"***

Only 39% of LEMSAs reported that they regularly use the core measure data. Most LEMSAs reported that they review the data only when a quality improvement issue arises (32%) or not at all (29%). The size of the LEMSA did not correlate with the likelihood of regular use of core measure data. At least in part, some of these challenges may result from the nature of the data acquisition for many LEMSAs as noted in the discussion of the previous survey questions. If the LEMSAs do not find the data acquisition process easy to use and have problems getting data from its various providers, it stands to reason that they might be less likely to find the data useful for improvement. If the data collection issues can be addressed, it is likely that the LEMSAs will find the data to be of more value.

Question 11: ***"What changes has your LEMSA made to better collect Core Measure data?"***

Thirteen of 31 (42%) LEMSAs reported software/hardware updates and provider outreach and training. Adding staff, training, and additional funding were reported by approximately 20% of the LEMSAs.

Question 12: ***"What changes would your LEMSAs find helpful in the Core Measure Project?"***

Twenty-three of 31 (74%) LEMSAs responded "better designed measures." When clarifying what was meant by "better designed measures" many LEMSAs commented on implementing fewer measures at the beginning of the project as they felt it challenging to focus on a large number of measures all at once. (Of note, the survey was unable to determine how much of an issue this remains, understanding that the Project is not entering its fifth year.) Many LEMSAs also reported they felt they had little input into the implementation and design of the Core Measures Project. Twelve (39%) LEMSAs reported that they would like increased guidance from the EMSA and increased technical support to assist with implementation.

Question 13: **Ability of the LEMSA to obtain Hospital Outcome Data such as Survival to Discharge**

Only 4 of 31 (13%) LEMSAs reported they were able to regularly obtain hospital outcome data. Sixteen of 31 (52%) LEMSAs reported obtaining hospital outcome data "Rarely" or "Never." This appeared to be a primary factor limiting compliance with several of the Core Measures.

Question 14: ***"Does your LEMSA participate in other data registries?"***

Most LEMSAs participate in other data registries. Twenty-five of 31 (81%) reported participation in trauma registries; 12 of 31 (39%) in STEMI registries; and 8 of 31 (26%) in cardiac arrest registries. Only 4 (13%) LEMSAs reported not participating in any registry. All of these were small LEMSAs. Over 50% of the large and medium LEMSAs participate in multiple registries, including STEMI, stroke and cardiac arrest. Only one small LEMSA participated in multiple registries. It appears that medium and large LEMSAs are willing to participate in data registries and have the resources available to do so. LEMSAs that participated in 1 or 2 registries had less than 1 FTE for data analysis. When participating in greater than 2 registries, LEMSAs had one or more FTE for data analysis.

Summary Findings

- California's 33 LEMSAs are highly diverse in size and resources available for data management.

- Most LEMSAs support multiple ALS providers – many having greater than 10 – which accentuates the challenges of getting useful and timely data for the Core Measures Project.

- Most LEMSAs have no or less than one staff person devoted to data input and analysis. The size of the LEMSA did not consistently correlate with the number of staff dedicated for data analysis. In contrast, LEMSA size appears to be a notable factor in participation in multiple condition-specific registries.

- Most LEMSAs reported lack of accurate reporting from EMS providers and software and core measure definition challenges as the biggest barriers for accurate Core Measures Project implementation.

- Most LEMSAs report that they do not use the Core Measures Project data regularly. Nearly a third of LEMSAs reported they do not use the Core Measures Project data for any purpose other than reporting to the EMSA. The reason for this could not be determined from the survey.

- The majority of the LEMSAs reported that fewer and more clearly defined and easily captured measures would have been helpful during the initial roll out of the initiative.

- A large majority of the LEMSAs reported difficulty in obtaining hospital outcome data.

Chapter 3. Review of EMS Core Measures Data, 2012-2015

An evaluation of the data reported in the EMSA's annual EMS Core Measures reports[23,24,25] was conducted by the project team. The reported data was interpreted based on the team's individual and collective expertise after being informed by the literature review and survey of LEMSAs. The 17 performance measures that constitute EMSA's core measure set are shown in figure 3.1. Importantly, we did not attempt to evaluate the validity of these measures nor whether they are the most appropriate or best measures to use to meet the goals of the EMS Core Measures Project; such assessments were beyond the scope of this project.

[23]Emergency Medical Services Authority. *EMS Core Measures Project. Reporting Capability of EMSA and LEMSA Data Systems and Results from Clinical Measures Reports Data Years 2012-2013*. Sacramento, CA. June 2014.
[24] Emergency Medical Services Authority. *EMS Core Measures Project. Reporting Capability of EMSA and LEMSA Data Systems and Results from Performance Measures Data Year 2014 With Comparison to Years 2012 and 2013*. Sacramento, CA. October 2015.
[25] Emergency Medical Services Authority. *EMS Core Measures Project. Reporting Capability of EMSA and LEMSA Data Systems and Results from Performance Measures Data Year 2015 With Comparison to Years 2012, 2013 and 2014*. Sacramento, CA. June 2016.

Figure 3.1. The EMSA core measure set.

Clinical Measures: Reports 2012-2015	
1	TRA-1 Scene time for trauma patients
2	TRA-2 Direct transport to designated trauma center for trauma patients meeting criteria
3	ACS-1 Aspirin administration for chest pain/discomfort rate
4	ACS-2 12 lead ECG performance
5	ACS-3 Scene time for suspected heart attack patients
6	ACS-5 Direct transport to designated STEMI receiving center for suspected patients meeting criteria
7	CAR-2 Out-of-hospital cardiac arrests return of spontaneous circulation
8	CAR-3: Out-Of-Hospital Cardiac Arrest Survival to Emergency Department Discharge
9	CAR-4: Out-Of-Hospital Cardiac Arrest Survival to Hospital Discharge
10	STR-2 Glucose testing for suspected acute stroke patients
11	STR-3 Scene time for suspected acute stroke patients
12	STR-5: Direct Transport to Stroke Center for Suspected Acute Stroke Patients Meeting Criteria
13	RES-2 Beta2 agonist administration for adult patients
14	PED-1 Pediatric patients with wheezing receiving bronchodilators
15	PAI-1: Pain Intervention
16	SKL-1 Endotracheal intubation success rate
17	SKL-2 End-tidal CO2 performed on any successful endotracheal intubation

1. TRA-1: Scene Time for Trauma Patients

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 13

Of the 23 LEMSAs reporting these data for 2013, the median scene time was approximately 22 minutes, essentially the same as last year. The common expectation is for short scene times, targeted at 15 minutes, with rapid transport to remain within a "golden hour" for care in a hospital with surgical capability. It may be worthwhile for LEMSAs to evaluate field protocols and actual provider field practices. Fifteen minutes may be unrealistic and unnecessary. Reported scene times may be influenced by extrication. The Golden Hour concept and trauma response time have both been challenged in the literature.

Data Year 2014, Page 13

Of the 28 LEMSAs reporting these data for 2014, the median scene time was 24 minutes, 30 seconds. Adjustments were made to the Trauma measures to analyze a larger population of trauma patients. Changes to the measures from the prior years include the removal of the revised trauma score to shift from examining those severely injured trauma patients, to all trauma patients meeting the CDC Trauma Triage Criteria.

The common expectation is for short scene times, targeted at 15 minutes, with rapid transport to remain within a "golden hour" for care in a hospital with surgical capability. It may be worthwhile for LEMSAs to evaluate field protocols and actual provider field practices. Fifteen minutes may be unrealistic and unnecessary. Reported scene times may be influenced by extrication. The Golden Hour concept and trauma response time have both been challenged in the literature.

Data Year 2014 with Comparison to 2012-2013, Page 15

Of the 28 LEMSAs reporting these data for 2014, the median scene time was 24 minutes, 30 seconds. Adjustments were made for 2014 to the Trauma measures to analyze a larger population of trauma patients. Changes to the trauma measures include the removal of the revised trauma score to shift from examining those severely injured trauma patients, to all trauma patients meeting the CDC Trauma Triage Criteria. This likely accounts for the increase in median time.

The common expectation is for short scene times, targeted at 15 minutes, with rapid transport to remain within a "golden hour" for care in a hospital with surgical capability. Reported scene times may be influenced by extrication. Moreover, the Golden Hour concept and trauma response time have both been challenged in the literature.

Data Year 2015 with Comparison to 2012-2014, Page 20

Of the 27 LEMSAs reporting these data for 2015, the median scene time was 23 minutes, 44 seconds. This is a decrease from 24 minutes, 30 seconds for 2014 data. 2015 data is the second year where the data where analyzed based on a revised trauma score that shifted from the more seriously injured to include all trauma patients meeting the CDC Trauma Triage Criteria.

IPHI Assessment

The discussion of the trauma scene time core measure notes the increase in responding LEMSAs from 23 in 2012 to 27 in the most recent data year (2015), which represents a notable increase in data collection and capture. It would be helpful to know the reasons underlying this increase, as well as why this relatively basic measure is not being reported by all LEMSAs. Moreover, as is noted elsewhere in the core measures data reporting, variation in the fraction of EMS providers within each LEMSA is fairly high, and it is difficult to know if this is a clinically meaningful response time given variability in response within and between LEMSAs even in those that responded to this core measure. Important as well is an understanding of the underlying quality of the data to be able to guide meaningful assessment of quality response metrics. For example, the scene time decreased from 24 minutes and 30 seconds in 2014, to 23 minutes and 44 seconds in 2015. It is not known, based on the report, if this was a statistically significant change, and the clinical impact of this on patients is unable to be assessed. Analysis of individual LEMSA performance data and change over time, rather than aggregate state level data, could be helpful in understanding the impact of quality improvement projects, as well as for assessing best practices and opportunities for improvement.

The reports also appropriately question some of the underlying assumptions behind the scene time measure, in particular the appropriateness of the 15 minute goal. Given increasing questions about the non-evidence based assumption of a golden hour in trauma, it is reasonable to question whether this particular time target is the correct one for EMS response in trauma. What is the underlying reason for variation between regions? Does it matter based on geography, call type, expected transport time, and similar variables? More complete data about the reasons why variation exists between regions would be helpful in understanding the appropriateness, or not, behind this variation. Consideration of subgroup analysis such as benchmarking to similar geographic and demographic regions would be useful.

2. TRA-2: Direct Transport to Designated Trauma Center for Trauma Patients Meeting Criteria

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 15

Of the 25 LEMSAs reporting these data for 2013, the median number of patients able to be transported directly to a trauma center was 82%, a significant increase from the year 1 median of 70.3%. Since the overall number of records analyzed declined, this is likely related to more refined inclusion criteria due to variability in definitions for a severely injured trauma patient and the revised trauma score. Variation between denominator values and the actual population of a region may reflect sampling. Moreover, direct transport to trauma centers for severely injured trauma patients will vary by geography and availability of resources in a given area, so expected values are very low or zero for LEMSAs without a trauma center or with long transport distances and times to a trauma center. To improve consistency, CDC guidelines will be used to define trauma patients for future measurements.

Data Year 2014, Page 15

Of the 27 LEMSAs reporting these data for 2014, the median number of patients able to be transported directly to a trauma center was 81%. Adjustments were made to the Trauma measures to analyze a larger population of trauma patients. Changes to the measures from the prior years include the removal of the revised trauma score to shift from examining those severely injured trauma patients, to all trauma patients meeting the CDC Trauma Triage Criteria.

Data Year 2014 with Comparison to 2012-2013, Page 17

Of the 27 LEMSAs reporting these data for 2014, the median of patients transported directly to a trauma center was 81%. Adjustments were made to the Trauma measures to analyze a larger population of trauma patients. Changes to the measures from the prior years include the removal of the revised trauma score to shift from examining severely injured trauma patients to all trauma patients meeting the Center for Disease Control Trauma Triage Criteria.

Low values would be expected in some rural areas with prolonged transport times to a trauma center. The measure does not distinguish among level of trauma center.

Data Year 2015 with Comparison to 2012-2014, Page 22

Of the 26 LEMSAs reporting these data for 2015, the median of patients transported directly to a trauma center was 83%. Adjustments were made to the Trauma measures to analyze a larger population of trauma patients in calendar year 2014 and 2015. Changes to the measures from

the prior years include the removal of the revised trauma score to shift from examining severely injured trauma patients to all trauma patients meeting the Center for Disease Control Trauma Triage Criteria.

Low values would be expected in some rural areas with prolonged transport times to a trauma center. The measure does not distinguish among level of trauma center.

IPHI Assessment

As noted in the report analysis over the multiple years, this measure does not allow for a consideration of the type of trauma center or the geography of a particular LEMSA region. In terms of benchmarking and best practices, these factors are important – i.e., not only are patients that meet criteria transported to a trauma center, but are they transported to the appropriate one?

Consideration of excluding or modifying the inclusion of rural regions needs to be evaluated. It is unclear and does not appear knowable from these data whether the individual patient data might cause transport to a non-trauma center to be the most appropriate course of action (e.g., unstable patient with extended transport to a trauma center as opposed to a short transport to a non-trauma center for initial stabilization, particularly in rural areas).

It would be beneficial to be able to compare similar regions on this measure, and use those cohorts to establish median and benchmarking since considerable variation appears to exist based on geography. From this, consideration of different targets could be made – while 100% transport to a trauma center is both desirable and possible in some LEMSAs, a more appropriate target might be lower in other regions. Moreover, being able to connect patient level data across the care continuum would be beneficial – for instance, are some patients initially seen at a non-trauma center, stabilized, and then transferred to a trauma center? How would that impact the overall numbers for LEMSAs in the lower end of the spectrum on this measure?

3. ACS-1: Aspirin Administration for Chest Pain/Discomfort Rate

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 17

Of the 27 LEMSAs reporting these data for 2013, the median number of patients receiving aspirin in the field for complaints of chest pain or discomfort suggestive of cardiac origin was 67.3%. Factors for a low reported value include lack of documentation, or aspirin administered by the patient/family or first responder paramedics but not reflected in the patient care record

by the ambulance transport service. Variation is also introduced by which chest pain patients are identified in the data search. The significant increase in the median as well as the increased records analyzed is likely due to methodological refinements and new LEMSAs reporting. The wide variation should not be attributed to performance at this time, but should prompt evaluation of protocols and discussion with field providers.

Data Year 2014, Page 17

Of the 31 LEMSAs reporting these data for 2014, the median percentage of patients receiving aspirin in the field for complaints of chest pain or discomfort suggestive of cardiac origin was 63%.

Factors for a low reported value include lack of documentation, or aspirin administered by the patient/family or first responder paramedics but not reflected in the patient care record by the ambulance transport service. Variation is also introduced by which chest pain patients are identified in the data search. The significant increase in the median as well as the increased records analyzed is likely due to methodological refinements and new LEMSAs reporting. The wide variation should not be attributed to performance at this time, but should prompt evaluation of protocols and discussion with field providers.

Data Year 2014 with Comparison to 2012-2013, Page 19

Of the 31 LEMSAs reporting these data for 2014, the median percentage of patients receiving aspirin in the field for complaints of chest pain or discomfort suggestive of cardiac origin was 63%.

Factors for a low reported value include lack of documentation, or aspirin administered by the patient/family or first responder paramedics but not reflected in the patient care record by the ambulance transport service. Variation is also introduced by which chest pain patients are identified in the data search. The number of LEMSAs reporting this measure increased from 27 to 31, leading to an increase in number of records analyzed; however, the median value decreased from 67% to 63%. This is likely due to methodological refinements and new LEMSAs reporting. The wide variation should not be attributed to performance at this time, but should prompt evaluation of protocols and discussion with field providers. Aspirin administration is the expected "standard of care" for chest pain and chest discomfort of cardiac origin. All 33 LEMSAs have aspirin administration in their protocol for management of suspected ACS patients.

Data Year 2015 with Comparison to 2012-2014, Page 24

Of the 29 LEMSAs reporting these data for 2015, the median percentage of patients receiving aspirin in the field for complaints of chest pain or discomfort suggestive of cardiac origin was 66.28%.

Factors for a low reported value include lack of documentation, or aspirin administered by the

patient/family or first responder paramedics but not reflected in the patient care record by the ambulance transport service. Variation is also introduced by which chest pain patients are identified in the data search. The number of LEMSAs reporting this measure decreased from 31 to 29; however, the median value increased from 63% to 66%.
Aspirin administration is the expected "standard of care" for chest pain and chest discomfort of cardiac origin. All 29 LEMSAs have aspirin administration in their protocol for management of suspected ACS patients

IPHI Assessment

As has been noted in nearly all the reported analyses on this measure over the years, it is unclear why this measure is so low despite protocols for aspirin administration in all suspected acute coronary syndrome patients. Given the wide range in reported performance, it is not clear if this results primarily from poor documentation in those systems with lower reported performance on this measure. As this is an important patient-centered process, a better understanding of why this variation exists – including more detailed inclusion and exclusion criteria – is important. Since the variation has persisted since the 2012-2013 data year, it seems likely that this variation is reflective of actual performance practice. A focused inquiry should be conducted into why a relatively simple measure like aspirin administration has so much variability in the reported data.

4. ACS-2: 12 Lead ECG Performance

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 19

Of the 28 LEMSAs reporting these data for 2013, the median number of patients receiving 12-Lead ECG in the field for complaints of chest pain or discomfort suggestive of cardiac origin was 80.8%. There was a marked increase in number of records analyzed and additional LEMSAs reporting, but the median increased minimally. There was moderate consistency in this measure, with most LEMSAs reporting 70- 100% compliance. Low values more likely represent data and methodological issues rather than actual performance. This measure is of particular importance with the widespread development of STEMI centers.

Data Year 2014, Page 19

Of the 31 LEMSAs reporting these data for 2014, the median number of patients receiving 12-Lead ECG in the field for complaints of chest pain or discomfort suggestive of cardiac origin was 87.86%.

There was a marked increase in number of records analyzed and additional LEMSAs reporting, but the median increased minimally. There was moderate consistency in this measure, with most LEMSAs reporting 70-100% compliance. Low values more likely represent data and methodological issues rather than actual performance. This measure is of particular importance with the widespread development of STEMI centers.

<u>Data Year 2014 with Comparison to 2012-2013, Page 21</u>

Of the 31 LEMSAs reporting these data for 2014, the median number of patients receiving 12-Lead ECG in the field for complaints of chest pain or discomfort suggestive of cardiac origin was 87.9%.

There was a marked increase in number of records analyzed and additional LEMSAs reporting. The median has increased significantly over the past 3 years. Additionally, there was moderate consistency in this measure, with most LEMSAs reporting 70-100% compliance. Low values more likely represent data and methodological issues rather than actual performance. This measure is of particular importance with the widespread development of STEMI centers. LEMSAs with a STEMI system in place are more likely to use 12 lead for identifying STEMI patients, a nationally recommended procedure by the American Heart Association. The draft STEMI regulations define "STEMI Patient" as one with characteristic symptoms of myocardial ischemia in association with persistent ST-Segment Elevation in ECG and that "The STEMI system policies shall address … identification of STEMI patients through the use of pre-hospital 12-lead ECG…" The American Heart Association has stated that the national goal is for an "in the field ECG." Thirty-one of 33 LEMSAs have developed STEMI systems and currently include field ECG in their management protocol.

<u>Data Year 2015 with Comparison to 2012-2014, Page 24</u>

Of the 29 LEMSAs reporting these data for 2015, the median number of patients receiving 12-Lead ECG in the field for complaints of chest pain or discomfort suggestive of cardiac origin was 85.81%.

While the median decreased for this report, there has been an increase over the past 3 years. Low values in this report more likely represent data and methodological issues rather than actual performance. This measure is of particular importance with the widespread development of STEMI centers. LEMSAs with a STEMI system in place are more likely to use 12 lead for identifying STEMI patients, a nationally recommended procedure by the American Heart Association. The draft STEMI regulations define "STEMI Patient" as one with characteristic symptoms of myocardial ischemia in association with persistent ST-Segment Elevation in ECG and that "The STEMI system policies shall address … identification of STEMI patients through the use of pre-hospital 12-lead ECG…" The American Heart Association has stated that the national goal is for an "in the field ECG." Thirty-one of 33 LEMSAs have developed STEMI systems and currently include field ECG in their management protocol.

IPHI Assessment

Similar to the aspirin measure, the field EKG for chest pain or cardiac concerns represents a patient-centered practice that is in line with national guidelines and recommendations. Interestingly, the performance on this measure is uniformly higher than for aspirin even though most prehospital providers performing an EKG should also be giving aspirin if they are following established protocols. Further exploration of the reason behind this gap could be helpful in understanding potential reporting and methodological differences and providing a better sense of the reliability of using these core measures data to track actual performance. Moreover, while the analysis of the low levels of EKGs in some LEMSAs over multiple years attributes the lower level to methodological and data collection issues, it is unclear why this might not instead reflect actual performance. A better understanding of the data collection process would help clarify what proportion of the low numbers are due to poor data versus poor performance.

As has been noted with other core measures, the available data makes it challenging to be able to interpret changes from year to year. It is not known if the change from 87.9% in 2014, to 85.81% in 2015 is significant; the difference between these numbers may not be meaningful, either statistically or clinically. Moreover, this is unlikely to be a clinically significant patient-centered outcome. Given the increasing presence of STEMI centers, as well as the emphasis on STEMI protocols and receiving centers, it is important to focus on the performance of this measure in a reliable, statistically, and clinically meaningful manner. For this and other measures, each LEMSA is responsible for reviewing and improving its performance against the target benchmarks set by EMSA.

5. ACS-3: Scene Time for Suspected Heart Attack Patients

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 21

Of the 28 LEMSAs reporting these data for 2013, the median scene time by ground ambulance for suspected heart attack patients with ST elevation on ECG was approximately 22 minutes and 44 seconds, slightly decreased from last year. There is considerable variation with most agencies between 18-28 minutes. Typically LEMSA protocols encourage paramedics to transport STEMI patients from the scene in 15 minutes or less since there is a time dependent goal to take the patient to the hospital catheterization suite to open blocked vessels. Further examination of this measure is warranted, including methodology, documentation, and validation. Given the evaluation and interventions needed for these patients, 15 minutes may be unrealistic.

Data Year 2014, Page 21

Of the 29 LEMSAs reporting these data for 2014, the median scene time by ground ambulance for suspected heart attack patients with ST elevation on ECG was approximately 21 minutes and 37 seconds, slightly decreased from prior year of reporting. There is considerable variation with most agencies between 17-24 minutes.
Typically LEMSA protocols encourage paramedics to transport STEMI patients from the scene in 15 minutes or less since there is a time dependent goal to take the patient to the hospital catheterization suite to open blocked vessels. Further examination of this measure is warranted, including methodology, documentation, and validation. Given the evaluation and interventions needed for these patients, 15 minutes may be unrealistic.

Data Year 2014 with Comparison to 2012-2013, Page 23

Of the 29 LEMSAs reporting these data for 2014, the median scene time by ground ambulance for suspected heart attack patients with ST elevation on ECG was approximately 21 minutes and 37 seconds, decreased about 10% from prior year of reporting. Over the past 3 years, there has been a progressive decrease in the mean. There is limited variation with most agencies between 20-25 minutes.

Typically LEMSA protocols encourage paramedics to transport STEMI patients from the scene in 15 minutes or less since there is a time dependent goal to take the patient to the hospital catheterization suite to open blocked vessels. Further examination of this measure is warranted, including methodology, documentation, and validation. According to the American Heart Association, the national goal is for a scene time of 15 minutes, although given the evaluation and interventions needed for these patients, 15 minutes may be unrealistic.
http://www.heart.org/HEARTORG/HealthcareResearch/MissionLifelineHomePage/EMS/EMS-Strategies-to-Achieve-Ideal_UCM_312066_Article.jsp

An (*) denotes the 24 LEMSAs with a STEMI Receiving Center

Data Year 2015 with Comparison to 2012-2014, Page 28

Of the 27 LEMSAs reporting these data for 2015, the median scene time by ground ambulance for suspected heart attack patients with ST elevation on ECG was approximately 23 minutes and 7 seconds and increased almost 90 seconds from the prior year of reporting. It is not clear what has caused the increase; over the past 3 years, there has been a progressive decrease in the mean.

Typically LEMSA protocols encourage paramedics to transport STEMI patients from the scene in 15 minutes or less since there is a time dependent goal to take the patient to the hospital catheterization suite to open blocked vessels. Further examination of this measure is warranted, including methodology, documentation, and validation. According to the American Heart Association, the national goal is for a scene time of 15 minutes, although given the evaluation

and interventions needed for these patients, 15 minutes may be unrealistic. *http://www.heart.org/HEARTORG/HealthcareResearch/MissionLifelineHomePage/EMS/EMS-Strategies-to-Achieve-Ideal_UCM_312066_Article.jsp*

Riverside EMS Agency was unable to aggregate information between 3 providers for this measure. While information was submitted, it is not represented table of reported values.

An (*) denotes the 24 LEMSAs with a STEMI Receiving Center

IPHI Assessment

Reported scene times have decreased with a slight uptick in the 2015 data year. It is not clear if these are statistically or clinically significant. The relatively wide variation in scene time – with only two providers meeting the AHA recommended 15-minute scene time level – should be further evaluated. Assuming the data are valid and comparable between the LEMSAs, an exploration of the reasons underlying longer scene times should be undertaken. Are interventions that matter for patients occurring when there are longer scene times? Is there a correlation between longer scene time and EKG performance? Both LEMSAs with scene times below 15 minutes were higher performers in terms of EKG performance and aspirin administration, which suggests that longer scene times are not required to perform these interventions. Further exploration of the reasons for shorter and longer scene times would help explain the variation and what factors are affecting EMS provider performance.

In addition, the ability to link patient level data throughout the care process at STEMI centers would be important to understand process times. Although the AHA recommends 15 minutes, the real measure of patient-centered importance is total time until revascularization – that is, the total time until revascularization should be minimized to optimize preservation of cardiac function. As a result, it is possible that a few extra minutes on scene might lead to lower total times until revascularization if that additional on-scene time is used well, or the opposite might be the case. Until more granular data elucidates these issues, the most prudent practice would be to work towards overcoming barriers to meeting the AHA recommended 15 minutes on scene to comply with national best practices. These issues underscore the need for timely exchange of information between the EMS providers and hospitals and ongoing efforts to promote health information exchange and interoperability between EMS providers and hospitals.

6. ACS-5: Direct Transport to Designated STEMI Receiving Center for Suspected Patients Meeting Criteria

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 23

Of the 27 LEMSAs reporting these data, the median number of patients appropriately transported directly to a STEMI center was 91.5%, unchanged from last year. STEM systems have been under local development for the past 5 years. Direct transport of patients to a STEMI centers with PCI capability will vary by geography, and availability of resources in a given area. Generally, LEMSAs with a higher level of direct transport are urban areas with a STEMI system in their geographic area. Lower values would be expected in a rural area which may not have an established STEMI system or one that can be accessed rapidly in a neighboring LEMSA.

Data Year 2014, Page 23

Of the 28 LEMSAs reporting these data, the median percentage of patients appropriately transported directly to a STEMI center was 96.86%, a significant increase from the prior year reporting.

Direct transport of patients to a STEMI centers with PCI capability will vary by geography, and availability of resources in a given area. Generally, LEMSAs with a higher level of direct transport are urban areas with a STEMI system in their geographic area. Lower values would be expected in a rural area which may not have an established STEMI system or one that can be accessed rapidly in a neighboring LEMSA.

Data Year 2014 with Comparison to 2012-2013, Page 25

Of the 28 LEMSAs reporting these data, the median percentage of patients appropriately transported directly to a STEMI center was 96.9%, a significant increase from the prior year reporting.

Direct transport of patients to a STEMI centers with percutaneous coronary intervention (PCI) capability will vary by geography and availability of resources in a given area. Generally, LEMSAs with a higher level of direct transport are often urban areas with a STEMI system in their geographic area. Lower values would be expected in a rural area that may not have an established STEMI system or one that can be accessed rapidly in a neighboring LEMSA. Several LEMSAs with measures below 90% may have STEMI systems, implying poor data quality or potential protocol violations.

24 of 33 LEMSAs have STEMI Receiving Center.

Data Year 2015 with Comparison to 2012-2014, Page 30

Of the 28 LEMSAs reporting these data, the median percentage of patients appropriately transported directly to a STEMI center was 95.85%. Direct transport of patients to a STEMI centers with percutaneous coronary intervention (PCI) capability will vary by geography and availability of resources in a given area. Generally, LEMSAs with a higher level of direct transport are often urban areas with a STEMI system in their geographic area. Lower values would be expected in a rural area that may not have an established STEMI system or one that can be accessed rapidly in a neighboring LEMSA. Several LEMSAs with measures below 90% may have STEMI systems, implying poor data quality or potential protocol violations.

An (*) denotes the 24 LEMSAs with a STEMI Receiving Center.

IPHI Assessment

The median transport numbers of patients directly transported to a STEMI center are overall quite good – with a median of almost 96%. This approaches the goal of 100%. Attaining 100% across the state is unlikely given the absence of STEMI centers in some areas, as well as potential issues with long transport times and patient cardiac arrest during transport, causing diversion. It would be helpful if these data could be reported with analysis based on the presence or absence of a STEMI center in the LEMSA catchment area. Of course, a LEMSA may have a STEMI center and still have problems reaching the 100% goal depending on transport times and geography, especially in rural regions. This issue should be further explored using more granular data. In addition, patient level data and linkages could help to investigate outcomes of patients not transported to a STEMI center initially and whether they were eventually transported to one.

To better understand issues related to data quality, reporting processes, and validity of this measure, it also would be helpful to analyze changes in performance over time. For example, San Francisco went from 84% in 2014 to 44% in 2015. This seems to be a significant change, although we cannot know from these data if it is statistically significant. This type of change needs to be further examined. Is this a real change in patient care and processes, or was there a change in how data is collected and reported? If the latter, then questions arise about the reliability of reporting statewide numbers which are derived from local data of uncertain reliability. Further evaluation of the reasons for this variability should be undertaken.

7. CAR-2: Out-Of-Hospital Cardiac Arrest Return of Spontaneous Circulation

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 25

Of the 27 LEMSAs reporting these data for 2013, the median number of patients that had a return of spontaneous circulation in the field after a cardiac arrest from all causes was 25.2%, unchanged from last year. Nationally, this rate varies considerably by state and by local agency. Most jurisdictions reported rates from 10-40%, which is credible. In addition to methodological challenges (evidenced by one LEMSA reporting 100%), this outcome measure is dependent upon multiple factors that vary considerably by community, including rapid public response, bystander CPR, automated external defibrillation use, response times by first responders and ALS providers, and presenting cardiac rhythm. At this time, these results should not be considered accurate measures of performance.

Data Year 2014, Page 25

Of the 30 LEMSAs reporting these data for 2014, the median number of patients that had a return of spontaneous circulation in the field after a cardiac arrest from all causes was 24.54%, a decrease from the prior year reporting.

Nationally, this rate varies considerably by state and by local agency. Most jurisdictions reported rates from 10-40%, which is credible. In addition to methodological challenges (evidenced by one LEMSA reporting 100%), this outcome measure is dependent upon multiple factors that vary considerably by community, including rapid public response, bystander CPR, automated external defibrillation use, response times by first responders and ALS providers, and presenting cardiac rhythm. At this time, these results should not be considered accurate measures of performance.

Data Year 2014 with Comparison to 2012-2013, Page 27

Of the 30 LEMSAs reporting these data for 2014, the median number of patients that had a return of spontaneous circulation in the field after a cardiac arrest from all causes was 24.5%, a decrease from the prior year reporting.

Nationally, this rate varies considerably by state and by local agency. Most jurisdictions reported rates from 10-40%, which is credible. In addition to methodological challenges (evidenced by one LEMSA reporting 100%), this outcome measure is dependent upon factors that vary considerably by community, including rapid public response, bystander CPR, community automated external defibrillation use, response times by first responders and ALS providers, and presenting cardiac rhythm. At this time, these results should not be considered

accurate measures of performance. Values vary widely, depending on multiple factors. National rate for return to spontaneous circulation is 40%. Values for a particular system should be used to track improvements.

An (*) on the table to the left designates Cardiac Arrest Registry to Enhance Survival (CARES) participants; the values are probably most reliable for these participants.

Data Year 2015 with Comparison to 2012-2014, Page 32

Of the 29 LEMSAs reporting these data for 2015, the median number of patients that had a return of spontaneous circulation in the field after a cardiac arrest from all causes was 24.06%, a decrease from 24.5% from the prior year reporting.

Nationally, this rate varies considerably by state and by local agency. Most jurisdictions reported rates from 10-40%, which is credible. In addition to methodological challenges (evidenced by one LEMSA reporting 100%), this outcome measure is dependent upon factors that vary considerably by community, including rapid public response, bystander CPR, community automated external defibrillation use, response times by first responders and ALS providers, and presenting cardiac rhythm. At this time, these results should not be considered accurate measures of performance. Values vary widely, depending on multiple factors. National rate for return to spontaneous circulation is 40%. Values for a particular system should be used to track improvements.

An (*) on the table to the left designates Cardiac Arrest Registry to Enhance Survival (CARES) participants; the values are probably most reliable for these participants.

IPHI Assessment

This is a challenging measure to interpret, but perhaps one of the most critical in terms of potential for EMS impact and process improvement, as well as public perception of performance. The analyses in the reports over the years appropriately cautions against using these data to compare one LEMSA against another, but if so, then it is problematic to aggregate the data to make statements about the state as a whole. One solution might be the aggregate together the CARES participants separately from non-participating agencies since those participating in CARES are more likely to have both consistent data, as well as reporting practices that can reliably be compared against other agencies in the database. That being said, the goal should be reliability of data across the state so the true level of performance can be assessed and used as a benchmark for improvement. The recommendation that each LEMSA's data should be used as a comparison against itself in prior years for quality improvement becomes problematic when considered from this point. After all, if the data is suspect in one year, it is not clear that the next year can be considered a more reliable basis of comparison even within the same system. The goal must be to have a reliable, reproducible data system

that allows for comparison over time to be able to identify best practices and improve performance where needed.

8. CAR-3: Out-Of-Hospital Cardiac Arrest Survival to Emergency Department Discharge

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 27

Of the 12 LEMSAs reporting these data for 2013, the median number of patients that had survived a return hospital cardiac arrest to be admitted to the hospital was 30.2%. This measure yielded a low number of responses from LEMSAs because of challenges obtaining hospital outcome data. Accurate measure of this outcome is an important future quality improvement goal and supports the need to develop exchange of health information with hospitals.

Data Year 2014, Page 27

Of the 12 LEMSAs reporting these data for 2014, the median number of patients that had survived a return hospital cardiac arrest to be admitted to the hospital was 23.50%. This measure yielded an increase of one LEMSA response from the prior year of reporting. Obtaining hospital outcome data continues to be a challenge faced by many LEMSAs. Accurate measure of this outcome is an important future quality improvement goal and supports the need to develop exchange of health information with hospitals.

Data Year 2014 with Comparison to 2012-2013, Page 29

Of the 12 LEMSAs reporting these data for 2014, the median number of patients that had survived a return hospital cardiac arrest to be admitted to the hospital was 23.50%. This measure included an increase of one LEMSA response from the prior year of reporting. Obtaining hospital outcome data continues to be a challenge faced by many LEMSAs. Accurate measure of this outcome is an important future quality improvement goal and supports the need to develop exchange of health information with hospitals. Marked variation is expected, but generally, this number is significantly less than the ROSC in the prior measure. Values vary widely, depending on multiple factors. Values for a particular system should be used to track improvements.

An (*) on the table to the left designates Cardiac Arrest Registry to Enhance Survival (CARES) participants; the values are probably most reliable for these participants.

Data Year 2015 with Comparison to 2012-2014, Page 34

Of the 11 LEMSAs reporting these data for 2015, the median number of patients that had

survived a return hospital cardiac arrest to be admitted to the hospital was 18.31%. Obtaining hospital outcome data continues to be a challenge faced by many LEMSAs. Accurate measure of this outcome is an important future quality improvement goal and supports the need to develop exchange of health information with hospitals. Marked variation is expected, but generally, this number is significantly less than the ROSC in the prior measure. Values vary widely, depending on multiple factors. Values for a particular system should be used to track improvements.

An (*) on the table to the left designates Cardiac Arrest Registry to Enhance Survival (CARES) participants; the values are probably most reliable for these participants.

IPHI Assessment

The analysis of this section appropriately notes the challenge in obtaining this type of outcome data, as well as its importance for understanding patient-centered outcomes and driving quality improvement. A couple issues are noteworthy. First, what is it about the 11 LEMSAs that reported data in the most recent year that allows them to obtain the data? Is this something that can be applied to other systems and geographic locations? Likewise, it is not clear what underlies the wide variation between those few systems that did report this measure. From the available data, it cannot be determined if the variation represents true performance variability (and, thus, a target for improvement), results from variations in data collection processes, or is a combination of both. Given the observed range of reported results, in comparison to national benchmark data, the reasons for the variable results should be further evaluated.

9. CAR-4: Out-Of-Hospital Cardiac Arrest Survival to Hospital Discharge

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 29

Of the 11 LEMSAs reporting these data for 2013, the median number of patients that had survived an out of hospital cardiac arrest and were discharged from the hospital was 11.5%. This measure yielded the lowest number of responses from LEMSAs because of the difficulties in obtaining hospital outcome data. Accurate measure of this outcome is an important future quality improvement goal and supports the need to develop exchange of health information with hospitals. An important refinement to this measure is the functional status on discharge.

Data Year 2014, Page 29

Of the 12 LEMSAs reporting these data for 2014, the median percentage of patients that had survived an out of hospital cardiac arrest and were discharged from the hospital was 8.51%. This measure yielded the lowest number of responses from LEMSAs because of the difficulties in obtaining hospital outcome data. Accurate measure of this outcome is an important future

quality improvement goal and supports the need to develop exchange of health information with hospitals. An important refinement to this measure is the functional status on discharge.

Data Year 2014 with Comparison to 2012-2013, Page 31

Of the 12 LEMSAs reporting these data for 2014, the median percentage of patients that had survived an out of hospital cardiac arrest and were discharged from the hospital was 8.5%. This measure yielded the lowest number of responses from LEMSAs because of the difficulties in obtaining hospital outcome data. Accurate measure of this outcome is an important future quality improvement goal and supports the need to develop exchange of health information with hospitals. An important refinement to this measure is the functional status on discharge. Values vary widely, depending on multiple factors. National rate for return to spontaneous circulation is 40% and survival to hospital discharge is 10%. Values for a particular system should be used to track improvements.

An (*) on the table to the left designates Cardiac Arrest Registry to Enhance Survival (CARES) participants; the values are probably most reliable for these participants.

Data Year 2015 with Comparison to 2012-2014, Page 36

Of the 11 LEMSAs reporting these data for 2015, the median percentage of patients that had survived an out of hospital cardiac arrest and were discharged from the hospital was 10.50%. This measure yielded the lowest number of responses from LEMSAs because of the difficulties in obtaining hospital outcome data. Accurate measure of this outcome is an important future quality improvement goal and supports the need to develop exchange of health information with hospitals. An important refinement to this measure is the functional status on discharge. Values vary widely, depending on multiple factors. National rate for return to spontaneous circulation is 40% and survival to hospital discharge is 10%. Values for a particular system should be used to track improvements.

An (*) on the table to the left designates Cardiac Arrest Registry to Enhance Survival (CARES) participants; the values are probably most reliable for these participants.

IPHI Assessment

As has been noted for both the CAR-2 and CAR-3 measures, similar challenges regarding hospital outcome data, patient linkages throughout the care continuum, and validity of the data reported by individual LEMSAs impact this important patient-centered measure. Again, understanding why some systems are able to report these data, the validity of the reported data, and the best practices underlying these factors will be important to expanding reporting of this core measure and using it for tracking resuscitation performance across the state and driving quality improvement. The ultimate goal should be survival to hospital discharge with a good functional outcome that is among the best in the nation. Gaining a better understanding

of system performance and best practices is critical to reaching this goal. Ongoing efforts to implement health information exchange should be helpful in this regard.

Although providing feedback on specific core measures was not within the scope of the IPHI review, we would offer a suggestion to consider regarding CAR-2, CAR-3, and CAR-4. Understanding how well a LEMSA performs in cardiac arrest treatment is a critical core measure. However, the heterogeneous grouping of all out of hospital cardiac arrests is not always helpful in determining the performance of EMS systems. Witnessed ventricular fibrillation arrests of cardiac origin are part of the Utstein Style of reporting and are a likely better assessment of EMS performance on a reversible cause of cardiac arrest. Many national EMS systems use this as a performance measure. Perhaps adding this as a core measure in place of CAR-2 or CAR-3 would be useful.

10. STR-2: Glucose Testing for Suspected Acute Stroke Patients

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 31

Of the 27 LEMSAs reporting these data for 2013, the median number of patients receiving glucose testing in the field for a possible stroke was 87%. The consistency of results suggests that the methodology of data extraction for this measure is less of a problem. Inconsistent low values are likely invalid. Diabetic causes of neurologic symptoms are important to exclude prior to transporting to a stroke center.

Data Years 2014, Page 31

Of the 31 LEMSAs reporting these data for 2014, the median percentage of patients receiving glucose testing in the field for a possible stroke was 89%. The consistency of results suggests that the methodology of data extraction for this measure is less of a problem. Inconsistent low values are likely invalid. Diabetic causes of neurologic symptoms are important to exclude prior to transporting to a stroke center.

Data Year 2014 with Comparison to 2012-2013, Page 33

Of the 31 LEMSAs reporting these data for 2014, the median percentage of patients receiving glucose testing in the field for a possible stroke was 89%. This has increased steadily over the three years of reporting. Inconsistent low values likely reflect data issues but should be evaluated for adherence to protocol. Diabetic causes of neurologic symptoms are important to exclude prior to transporting to a stroke center and are part of stroke protocols. 32/33 LEMSAs have protocols that advise routine evaluation of blood sugar in suspected stroke patients.

An (*) indicates 22 LEMSAs that have developed a stroke system with a designated primary stroke receiving center. There are currently draft stroke regulations being finalized. In future reports, EMSA will be able to clearly identify the stroke systems statewide.

Data Year 2015 with Comparison to 2012-2014, Page 38

Of the 29 LEMSAs reporting these data for 2015, the median percentage of patients receiving glucose testing in the field for a possible stroke was 92.90%. Inconsistent low values likely reflect data issues but should be evaluated for adherence to protocol. Diabetic causes of neurologic symptoms are important to exclude prior to transporting to a stroke center and are part of stroke protocols. 32/33 LEMSAs have protocols that advise routine evaluation of blood sugar in suspected stroke patients.

An (*) indicates 22 LEMSAs that have developed a stroke system with a designated primary stroke receiving center. There are currently draft stroke regulations being finalized. In future reports, EMSA will be able to clearly identify the stroke systems statewide.

IPHI Assessment

As the analysis in the annual reports indicate, measurement of glucose in neurological and stroke symptoms is an important intervention and is recommended by both national guidelines and local protocols. Some systems approach 100%, although no system reaches that goal. This is a similar theme as with some other core measures. While there are clearly many data issues that need to be evaluated and worked out, it is problematic to assume that all variation is the result of data collection when it is not known if this is the case. Further investigation of the differences between systems reporting high and low values is needed. Are the same systems consistently reporting high values on all measures? If so, does this indicate good data capture or good practice? It is possible that these may be related. Clearly, the ability to use core measures as an important quality benchmark and as a focus for improvement efforts requires that the data be considered reliable and valid. Notwithstanding this important issue, individual system data can be used over time to track changes in performance and quality metrics, as well as to identify best practices that can be applied across systems.

11. STR-3: Scene Time for Suspected Acute Stroke Patients

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 33

Of the 26 LEMSAs reporting these data for 2013, the median scene time by an ambulance for suspected stroke patients was approximately 20 minutes, a reduction of 2 minutes compared to

last year. Nearly all local jurisdiction average times for this measure ranged between 14 and 24 minutes. Typically, LEMSA protocols in California encourage paramedics to transport stroke patients from the scene in 15 minutes or less; however, this may not be realistic for many patients who require more time for history, examination, and extraction from their residence. Stroke evaluation and treatment is a time sensitive measure, so extra minutes in the field add up with additional delays within the healthcare system. Further examination of this measure is warranted, including methodology, documentation, and validation.

Data Year 2014, Page 33

Of the 30 LEMSAs reporting these data for 2014, the median scene time by an ambulance for suspected stroke patients was approximately 20 minutes and 43 seconds.
Nearly all local jurisdiction average times for this measure ranged between 15 and 26 minutes. Typically, LEMSA protocols in California encourage paramedics to transport stroke patients from the scene in 15 minutes or less; however, this may not be realistic for many patients who require more time for history, examination, and extraction from their residence. Stroke evaluation and treatment is a time sensitive measure, so extra minutes in the field add up with additional delays within the healthcare system. Further examination of this measure is warranted, including methodology, documentation, and validation.

Data Year 2014 with Comparison to 2012-2013, Page 35

Of the 30 LEMSAs reporting these data for 2014, the median scene time by an ambulance for suspected stroke patients was approximately 20 minutes and 43 seconds, not significantly different from last year. Times from all local jurisdictions reporting ranged between 15 and 28 minutes. 19/33 (58%) of LEMSAs have protocols that direct EMS to limit time on scene. Time targets may not be realistic for many patients who require more time for history, examination, and extraction from their residence. Stroke evaluation and treatment is a time sensitive measure, so extra minutes in the field add up with additional delays within the healthcare system. Further examination of this measure is warranted, including methodology, documentation, and validation.

An (*) indicates 22 LEMSAs that have developed a stroke system with a designated primary stroke receiving center. There are currently draft stroke regulations being finalized. In future reports, EMSA will be able to clearly identify the stroke systems statewide.

Data Year 2015 with Comparison to 2012-2014, Page 40

Of the 26 LEMSAs reporting these data for 2015, the median scene time by an ambulance for suspected stroke patients was approximately 20 minutes and 29 seconds, not significantly different from the previous year. Times from all local jurisdictions reporting ranged between 12 and 25 minutes. 19/33 (58%) of LEMSAs have protocols that direct EMS to limit time on scene. Time targets may not be realistic for many patients who require more time for history, examination, and extraction from their residence. Stroke evaluation and treatment is a time

sensitive measure, so extra minutes in the field add up with additional delays within the healthcare system. Further examination of this measure is warranted, including methodology, documentation, and validation.

An (*) indicates 22 LEMSAs that have developed a stroke system with a designated primary stroke receiving center. There are currently draft stroke regulations being finalized. In future reports, EMSA will be able to clearly identify the stroke systems statewide.

IPHI Assessment

Similar to the core measure on suspected heart attack scene times, this is a challenging measure to interpret and needs further examination of the underlying data and assumptions. From the information provided in the report, we do not know about the statistical validity of the variation between systems – that is, does the 12-minute scene time in some systems compare to the 25 minute in another in a statistically significant manner, or are they both within the range of error given the available data. The same question applies to the entire data year as a whole and comparing it across years. While there has not been much change across years in this measure, the available data and report does not allow one to get a sense of the actual change given sample size and potential sampling error. While it would be desirable to be able to perform statistical analysis (e.g., standard errors and correlation on various core measures within and among LEMSAs), we believe questions about the underlying data preclude this.

In addition to issues of data monitoring and collection, the analysis raises the question of whether the stated target of 15 minutes in most LEMSA protocols is the appropriate goal. Given that the overall goal of stroke care is rapid identification and transfer to stroke centers for patients that would potentially benefit from interventional therapy, the ultimate goal is as short as possible total time in the entire health care system before intervention (when intervention is indicated). Until patient level data and hospital outcomes are available, short scene time is the best available indicator for the EMS component of stroke quality. Since some systems are able to meet the 15-minute goal, further exploration of the system details, data reporting, best practices, and reasons for variation, including geographical constraints, is warranted before changing the target goal.

12. STR-5: Direct Transport to Stroke Center for Suspected Acute Stroke Patients Meeting Criteria

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 35

Of the 20 LEMSAs reporting these data for 2013, the median number of patients transported directly to a Stroke center by ground ambulance was 86%, a significant increase from last year. Direct transport of patients to a Stroke center will vary by geography and availability of resources in a given area. Lower values are expected in rural areas or jurisdictions that do not have an established system with designated specialty care hospitals or rapid access to a center in a neighboring jurisdiction.

Data Years 2014, Page 35

Of the 21 LEMSAs reporting these data for 2014, the median number of patients transported directly to a Stroke center by ground ambulance was 93%, a significant increase from last year. Direct transport of patients to a Stroke center will vary by geography and availability of resources in a given area. Lower values are expected in rural areas or jurisdictions that do not have an established system with designated specialty care hospitals or rapid access to a center in a neighboring jurisdiction.

Data Year 2014 with Comparison to 2012-2013, Page 37

Of the 21 LEMSAs reporting these data for 2014, the median number of patients transported directly to a Stroke center by ground ambulance was 93%, with a steady and significant increase over the past three years.

Direct transport of patients to a Stroke center will vary by geography and availability of resources in a given area. Lower values are expected in rural areas or jurisdictions that do not have an established system with designated specialty care hospitals or rapid access to a center in a neighboring jurisdiction.

An (*) represents the 22 LEMSAs that have a designated primary stroke receiving center. There are currently draft stroke regulations in the process of being finalized. The goal in a stroke system is to transport 100% of stroke patients to a designated stroke center.

Data Year 2015 with Comparison to 2012-2014, Page 42

Of the 22 LEMSAs reporting these data for 2015, the median number of patients transported directly to a Stroke center by ground ambulance was 89%. Direct transport of patients to a Stroke center will vary by geography and availability of resources in a given area. Lower values

are expected in rural areas or jurisdictions that do not have an established system with designated specialty care hospitals or rapid access to a center in a neighboring jurisdiction.

An (*) represents the 22 LEMSAs that have a designated primary stroke receiving center. There are currently draft stroke regulations in the process of being finalized. The goal in a stroke system is to transport 100% of stroke patients to a designated stroke center.

IPHI Assessment

Similar to other core measures, it is difficult to know from the available data whether changes in stroke center transport from year to year represent statistically significant changes or random variation. It is also difficult to make conclusions about variation among systems. That being said, many systems are able to approach the 100% goal in this measure. The presence of a primary stroke receiving center and the resultant protocols will obviously impact this value, but not all primary stroke receiving center systems have near 100% performance. Further analysis of the data within and across LEMSAs is necessary to understand the cause of this variation. Is it due to geography and transport times? This is a logical assumption, but can only be an assumption until tested against the data within and across LEMSAs. It is also likely that some of the data and reporting is not correct in so far as some systems with primary stroke receiving centers reported 0% direct transport on this measure. Similar issues impact the core measures regarding STEMI and trauma center transport. Additional detailed analysis of the data gaps at the LEMSA level might improve all of these transport related measures.

13. RES-2: Beta2 Agonist Administration for Adult Patients

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 37

Of the 27 LEMSAs reporting these data for 2013, the median number of patients receiving a Beta-2 Agonist/bronchodilator for bronchospasm in adults (age 14 or older) was 61%, slightly less than last year. Values do appear to cluster near the median. This measure likely has challenges identifying the appropriate denominator of patients for whom a bronchodilator is indicated.

Data Year 2014, Page 37
Of the 29 LEMSAs reporting these data for 2014, the median percentage of patients receiving a Beta-2 Agonist/bronchodilator for bronchospasm in adults (age 14 or older) was 67% an increase from the last year.

This measure likely has challenges identifying the appropriate denominator of patients for

whom a bronchodilator is indicated.

Data Year 2014 with Comparison to 2012-2013, Page 39

Of the 29 LEMSAs reporting these data for 2014, the median percentage of patients receiving a Beta-2 Agonist/bronchodilator for bronchospasm in adults (age 14 or older) was 67%, an increase from 61.5% last year. The marked variability for this measure suggests challenges identifying the appropriate denominator of patients for whom a bronchodilator is indicated. Treatment protocols for which adult patients should receive Beta2 agonists may vary and clinical differentiation is difficult.

Data Year 2015 with Comparison to 2012-2014, Page 44

Of the 27 LEMSAs reporting these data for 2015, the median percentage of patients receiving a Beta-2 Agonist/bronchodilator for bronchospasm in adults (age 14 or older) was 37.21%, a decrease from 67.69% last year. The marked variability for this measure suggests challenges identifying the appropriate denominator of patients for whom a bronchodilator is indicated.

Treatment protocols for which adult patients should receive Beta2 agonists may vary and clinical differentiation is difficult.

IPHI Assessment

This measure has marked variation in reported results, ranging from about 4% to about 92%, with a clustering around a median of 37% in 2015. Given this range and the inability to make statistical claims of variation across data years and LEMSAs, it is difficult to know how to interpret the results reported for this core measure. Further investigation of the reasons for variation across LEMSAs should be undertaken. Is the data being collected and reported in a significantly different way? Is patient care markedly different? Of course, there will be considerable clinical variation given the heterogeneous clinical presentation in adults, but if this core measure is to be included then data collection needs to be standardized. As the prior analysis has suggested, there are likely challenges identifying the appropriate denominator. These challenges need to be properly identified, addressed and refined so that this core measure can be reliably used for process improvement. If this is not possible, then the utility of continued inclusion of this measure should be assessed. Additionally, the measure could be further refined to specify clinically meaningful inclusion and exclusion criteria.

14. PED-1: Pediatric Patients With Wheezing Receiving Bronchodilators

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 39

Of the 27 LEMSAs reporting these data for 2013, the median number of pediatric patients receiving bronchodilators for asthma was 64.2%. This is a slight decrease from last year's value but similar to the equivalent adult measure, suggesting similar methodological issues. The pediatric measure should have more validity than the adult, since shortness of breath with wheezing in children is more likely due to asthma than adult symptoms that may be due to cardiac or chronic lung disease. Examination of this measure is recommended to ensure proper patient inclusion and documentation. It is not clear why the spectrum of results would be so variable. The measure would be more accurately titled "pediatric patients with wheezing receiving bronchodilators". Although this may be caused by other medical problems, wheezing in any population is not pathognomonic of asthma.

Data Year 2014, Page 39

Of the 29 LEMSAs reporting these data for 2014, the median number of pediatric patients receiving bronchodilators for asthma was 60.62%. This is a slight decrease from last year's value but similar to the equivalent adult measure, suggesting similar methodological issues. The pediatric measure should have more validity than the adult, since shortness of breath with wheezing in children is more likely due to asthma than adult symptoms that may be due to cardiac or chronic lung disease. Examination of this measure is recommended to ensure proper patient inclusion and documentation. It is not clear why the spectrum of results would be so variable

Data Year 2014 with Comparison to 2012-2013, Page 41

Of the 29 LEMSAs reporting these data for 2014, the median number of pediatric patients receiving bronchodilators for asthma was 60.6%. The decrease over the last 3 years suggests methodological issues rather than performance. The pediatric measure should have more validity than the adult, since shortness of breath with wheezing in children is more likely due to asthma than adult symptoms that may be due to cardiac etiology. It is not clear why the spectrum of results would be so variable. One reason may be multiple doses administered at the home prior to arrival of EMS or dose administered by first responders. Examination of this measure is recommended to ensure proper patient inclusion and documentation.

Data Year 2015 with Comparison to 2012-2014, Page 46

Of the 27 LEMSAs reporting these data for 2015, the median number of pediatric patients receiving bronchodilators for asthma was 29.00%. The decrease over the last 4 years suggests methodological issues rather than performance. The pediatric measure should have more

validity than the adult, since shortness of breath with wheezing in children is more likely due to asthma than adult symptoms that may be due to cardiac etiology. It is not clear why the spectrum of results would be so variable. One reason may be multiple doses administered at the home prior to arrival of EMS or dose administered by first responders. Examination of this measure is recommended to ensure proper patient inclusion and documentation.

IPHI Assessment

Similar to the discussion on adult bronchodilator use, this is a challenging measure to interpret. There are likely data collection and recording issues, as well as clinical heterogeneity. The data in the reports do not address statistical validity and significance, either across years or within systems. We can assume, for example, that a system with 100% performance but only 3 cases in 2015 is not statistically significant (although we do not know that with certainty without more detailed analysis), but there is still marked variability, ranging from almost 3% in 2015 to 93%, with a median of 29%. This range, as well as the low median, indicates a need for further evaluation of this core measure, standardization of data collection processes, and consideration about whether and how to include the measure. As in previous core measures, detailed analysis of high and low reporters would be helpful for understanding what amount of the variation is due to data reporting and capture versus actual clinical and system performance issues.

15. PAI-1: Pain Intervention

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 41

Of the 19 LEMSAs reporting these data for 2013, the median percentage of patients receiving intervention for any pain reported as 7 or greater on a 10 point pain scale was 33.2%. Pain intervention was defined as any analgesic medication or accepted procedure to reduce pain. The low average and wide variation in the results suggest methodological challenges.

Data Year 2014, Page 41

Of the 22 LEMSAs reporting these data for 2014, the median percentage of patients receiving intervention for any pain reported as 7 or greater on a 10 point pain scale was 39%. Pain intervention was defined as any analgesic medication or accepted procedure to reduce pain.

Data Year 2014 with Comparison to 2012-2013, Page 43

Of the 22 LEMSAs reporting these data for 2014, the median percentage of patients receiving intervention for any pain reported as 7 or greater on a 10-point pain scale was 39%. Pain intervention was defined as any analgesic medication or accepted procedure to reduce pain.

All paramedics have access to narcotics; however protocols for use may vary significantly. Some may have received pain medication from first responders. The wide variation deserves closer investigation.

Data Year 2015 with Comparison to 2012-2014, Page 46

Of the 25 LEMSAs reporting these data for 2015, the median percentage of patients receiving intervention for any pain reported as 7 or greater on a 10-point pain scale was 32.40%. Pain intervention was defined as any analgesic medication or accepted procedure to reduce pain.

All paramedics have access to narcotics; however protocols for use may vary significantly. Some may have received pain medication from first responders. The wide variation deserves closer investigation.

IPHI Assessment

The reports appropriately question the wide variation in reported results and indicate that further investigation is needed to understand the reasons for the variation. Given that substantial variation has persisted across all reporting periods, continued use of this measure makes sense. Pain intervention is important for patient-centered care, and national quality goals focus on pain relief. That said, further investigation is needed about why the numbers are low for the state as a whole and why the variation is so marked. Are there appropriate exceptions documented (e.g., allergy, previous pain medication by first responders, patient refusal, chronic pain, etc.)? Transport time could play a role as well; that is, systems with short transport times may be less likely to administer pain medication. The available data do not provide answers to these questions. Consideration might be given to refinement of the denominator to include certain types of pain (e.g., suspected long bone fracture) instead of a patient rated pain number. As in several previous measures, the range from 12% to 98% indicates the need for further evaluation of the reason for such a wide range of performance. Given the importance of pain relief to the patient experience, working at the LEMSA level to ensure improved performance is important.

16. SKL-1: Endotracheal Intubation Success Rate

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 43

Of the 25 LEMSAs reporting these data for 2013, the median percentage of successful endotracheal intubations (within 2 attempts) was 75%. The slightly lower value compared to last year is likely related to refined measurement. The median is consistent with values reported in the literature. Bias may result because results are not based on verification in the emergency department.

Data Years 2014, Page 43

Of the 30 LEMSAs reporting these data for 2014, the median percentage of successful endotracheal intubations (within 2 attempts) was 72.87%. The slightly lower value compared to last year.

Data Year 2014 with Comparison to 2012-2013, Page 45

Of the 30 LEMSAs reporting these data for 2014, the median percentage of successful endotracheal intubations (within 2 attempts) was 72.9%. Endotracheal intubation success rate by paramedics in the field vary widely from 60-90% with an average of 72%, depending on methods, population and protocol.

It is unclear why this value has decreased over the past 3 years. Other methods of airway management have recently been shown to be as effective as intubation. It is important to monitor this measure to verify skill maintenance.

Data Year 2015 with Comparison to 2012-2014, Page 50

Of the 28 LEMSAs reporting these data for 2015, the median percentage of successful endotracheal intubations (within 2 attempts) was 73.37%. Endotracheal intubation success rate by paramedics in the field was an average of 72.73%, depending on methods, population and protocol.

It is unclear why this value has decreased over the past 3 years. Other methods of airway management have recently been shown to be as effective as intubation. It is important to monitor this measure to verify skill maintenance.

IPHI Assessment

The reports raise questions about why the intubation success rates have decreased in recent years. It is possible that success rates may be within appropriate confidence intervals. In

addition, other methods of airway management (e.g., perilaryngeal or supraglottic devices) are increasingly being utilized in cardiac arrest and other compromised airway situations. It is possible that if the lower rates are statistically significant, this may be from patient selection – i.e., different patient types have fewer intubation attempts than previously, which could impact success rate. The available data are not sufficient to make this determination, and further investigation is needed. Consideration of a composite measure ("airway success" with either endotracheal intubation or with a supraglottic device) may be warranted if the relevant data can be extracted.

Despite these important issues, there still remains considerable variation in the LEMSA reported data, and we do not know if this variation is the result of data collection or true differences in practice. With success rate in 2015 ranging from 44% to almost 93%, it is important for LEMSAs to delve deeper and understand what is driving the difference. Is it just variable reporting? Is there a true skill and quality difference? If there are true differences, what are the best practices that can be applied across systems to make a difference in patient care? Moreover, it would be beneficial to the individual LEMSAs if a target benchmark would be provided by EMSA against which individual performance can be measured.

17. SKL-2: End-tidal CO2 Performed on any Successful Endotracheal Intubation

EMSA Reported Findings and Interpretation/Comments

Data Year 2012-2013, Page 45

Of the 22 LEMSAs reporting these data for 2013, the median percentage of End-Tidal CO2 monitoring with waveform capnography after any successful endotracheal intubations was 78.8%. The value decreased from last year but included 40% more records. Following clinical best practices, this indicator should be 100%, so
it is important for local jurisdictions to evaluate whether this is documentation, a practice issue, or protocol deficiency.

Data Year 2014, Page 45

Of the 29 LEMSAs reporting these data for 2014, the median percentage of End-Tidal CO2 monitoring with waveform capnography after any successful endotracheal intubations was 91%. The value increased from last year. Following clinical best practices, this indicator should be 100%, so it is important for local jurisdictions to evaluate whether this is documentation, a practice issue, or protocol deficiency.

Data Year 2014 with Comparison to 2012-2013, Page 47

Of the 29 LEMSAs reporting these data for 2014, the median percentage of End-Tidal CO2 monitoring with waveform capnography after any successful endotracheal intubations was 91%. The value significantly increased from last year, but has been variable over the three years of measurement. Following clinical best practices, this indicator should be 100%, so it is important for local jurisdictions to evaluate whether this is documentation, a practice issue, or protocol deficiency

Data Year 2015 with Comparison to 2012-2014, Page 50

Of the 28 LEMSAs reporting these data for 2015, the median percentage of End-Tidal CO2 monitoring with waveform capnography after any successful endotracheal intubations was 88.25%. The value significantly increased from last year, but has been variable over the three years of measurement. Following clinical best practices, this indicator should be 100%, so it is important for local jurisdictions to evaluate whether this is documentation, a practice issue, or protocol deficiency.

IPHI Assessment

As appropriately noted in the reports, waveform capnography is a best practice post-intubation to verify and monitor tube placement, especially during transport. Although the overall statewide median value approaches 90%, the average is only about 75%. This is unacceptable for a value that should be 100%. Given that some systems report 100% compliance, further investigation is needed to determine if this is primarily a data issue or an actual problem with performance, protocols, or lack of equipment. This should be further explored by LEMSAs to ensure that local systems performing intubations are able to perform capnography monitoring.

Chapter 4. EMS Core Measures Literature Review

A review of the literature about EMS core measures was conducted using Google, Google Scholar and PubMed search engines. The search terms that were used included: *EMS core measures, EMS quality improvement, EMS measures, EMS/pre-hospital care quality improvement performance measures, EMS performance measures, pre-hospital care performance measures, pre-hospital care quality improvement, cardiac arrest, cardiac arrest pre-hospital care performance measures, trauma care, trauma care pre-hospital care performance measures, STEMI, STEMI pre-hospital care performance measures, stroke and stroke pre-hospital care performance measures*. Reference lists of identified articles were reviewed and mined for potentially project-relevant references. Inclusion criteria for references included in this review were: published in English, published in or after 2005, and directly addressed EMS quality improvement. The majority of articles initially identified were reviewed and deemed not to meet the inclusion criteria. The 37 articles meeting inclusion criteria are briefly summarized below. Consistent with directions for the project provided by the EMSA, we did not assess the literature with regard to use of specific EMS core measures.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US	A quality improvement initiative to optimize use of a mechanical chest compression device within a high-performance CPR approach to out-of-hospital cardiac arrest resuscitation (Levy, 2015)	Resuscitation	A targeted quality improvement initiative achieved a significant reduction in the duration of the primary CPR interruption associated with application of a mechanical CPR device. American Heart Association guidelines can serve as a training model for the use of the mechanical CPR device.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US	A quantitative analysis of out-of-hospital pediatric and adolescent resuscitation quality--A report from the ROC epistry-cardiac arrest (Sutton, 2015)	Resuscitation	Prehospital rescuer CPR frequently did not meet AHA guidelines during p-OHCA resuscitation attempts. Less than 25% of the resuscitations met both rate and CPR fraction targets despite a definition of event compliance requiring only 60% of the minutes to achieve quality goals.
US	An Evidence-based Guideline for Pediatric Prehospital Seizure Management Using GRADE Methodology (Shah, 2014)	Prehospital Emergency Care	It is recommended that all patients in an active seizure have capillary blood glucose checked and be treated with IV dextrose or IM glucagon. Non-IV routes of benzodiazepines are advised over the rectal route as first-line therapy.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US	An Evidence-based Guideline for Prehospital Analgesia in Trauma (Gausche-Hill, 2014)	Prehospital Emergency Care	It is recommended that all patients be considered for analgesia, regardless of transport interval, and that opioids should be considered for those with moderate to severe pain. Frequent patient reassessment using a standardized pain scale is advised, and patients should be re-dosed if pain continues. A specific pain assessment tool could not be strongly recommended, and it is important to note that the pediatric patient population is underrepresented.
US	An Evidence-based Guideline for the Air Medical Transportation of Prehospital Trauma Patients (Thomas, 2014)	Prehospital Emergency Care	The 2011 CDC Guideline for the Field Triage of Injured Patients is strongly recommended as the initial step in the triage process. Ground emergency medical services (GEMS) should be used for patients not meeting CDC anatomic, physiologic, and situational high-acuity criteria. Helicopter emergency medical services (HEMS) is weakly recommended if there is a time-saving component versus GEMS or if an appropriate hospital is not accessible by GEMS. Online medical direction should not be required for activating HEMS.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US	EMS Performance Measures Project Report EMS Performance Measures: Recommended Attributes and Indicators for System and Service Performance (National Association of EMS Officials, 2009)	NHTSA (Report)	The document contains 18 performance questions and 35 indicators or attributes.
US	Evidence-based Guidelines for Prehospital Practice: A Process Whose Time Has Come (Wright, 2014)	Prehospital Emergency Care	The scientific contribution of manuscripts focusing on the National Prehospital Evidence-based Guideline Model Process has initiated systematic attempts to apply evidence-based principles to a national process of prehospital protocol development.
US	Evidence-based performance measures for emergency medical services systems: a model for expanded EMS benchmarking (Myers, 2008)	Prehospital Emergency Care	The 2007 U.S. Metropolitan Municipalities' EMS Medical Directors' Consortium developed a model that encompasses a broader range of clinical situations, including myocardial infarction, pulmonary edema, bronchospasm, status epilepticus, and trauma. This approach may be utilized in a benchmarking fashion so that best practices in urban and suburban EMS systems may be quantified and reproduced.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US	Hospital-directed feedback to Emergency Medical Services improves prehospital performance (Choi, 2014)	Stroke	Hospital-directed feedback to EMS was associated with improved overall compliance with Rhode Island state protocols and documentation of 9 out of 10 individual items.
US	How to measure and improve EMS systems. EMS Compass is setting the profession on a path toward performance measurement and improvement. (Gerber, 2016)	EMS World (Trade Magazine)	The National Association of State EMS Officials (NASEMSO) publicly launched EMS Compass in 2014. The focus of EMS Compass is to create a replicable process for identifying, designing and testing performance measures—a process that can be used by organizations wanting to develop measures that support improving prehospital medical care.
US	Lack of emergency medical services documentation is associated with poor patient outcomes: a validation of audit filters for prehospital trauma care (Laudermilch, 2010)	Journal of the American College of Surgeons	Failure of EMS to document basic measures of scene physiology is associated with increased mortality. This deviation in care can serve as a sensitive audit filter for performance improvement.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US	National Prehospital Evidence-Based Guidelines Strategy: A Summary for EMS Stakeholders (Martin-Gill, 2016)	Prehospital Emergency Care	Seven action items that support collaborative efforts in advancing prehospital evidence-based guidelines (EBGs) are: 1) Create a Prehospital Guidelines Consortium to facilitate communication between organizations working on EBG-related projects. 2) Promote EBG research. 3) Promote EBG development. 4) Improve EBG education. 5) Facilitate EBG implementation in healthcare settings. 6) Standardize evaluation methods. 7) Promote funding.
US	Pay for Performance Improves Rural EMS Quality: Investment in Prehospital Care (Whyte, 2008)	Prehospital Emergency Care	Tracking data and financially rewarding EMS providers for meeting targets improved results and suggest that a pay-for-performance incentive complements traditional EMS quality assurance methods.
US	Primary percutaneous coronary intervention for patients presenting with ST-elevation myocardial infarction: process improvements in rural prehospital care delivered by emergency medical services (Rezaee, 2010)	Progress in Cardiovascular Diseases	EMS providers achieved further reductions in median E2B of approx. 24 minutes when prehospital ECGs were combined with prehospital CCL activation. Results indicate that rural PCI-capable medical centers and resource-limited EMS providers can significantly improve regional prehospital STEMI care when quality improvement is approached as a systems-based, collaborative effort.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US	Quality Improvement in EMS: A Unique and Challenging Necessity (Tsai, 2014)	Rhode Island Medical Journal	EMS QI implementation challenges can be overcome by recognizing EMS as part of the health care team, by improving the performance evaluation and feedback process, through electronic charting and collection of meaningful data, by adopting a "commitment to resilience" model, and by regularly debriefing and examining near-misses.
US	Recognition of Stroke by EMS is Associated with Improvement in Emergency Department Quality Measures (Abboud, 2016)	Prehospital Emergency Care	Correct EMS recognition of stroke resulted in faster evaluation and treatment in-hospital. However, the study found that EMS providers failed to recognize more than 40% of stroke cases.
US	The Development of Evidence-based Prehospital Guidelines Using a GRADE-based Methodology (Brown, 2014)	Prehospital Emergency Care	The development and initial implementation processes for three prehospital evidence-based guidelines are divided into six steps, with the rationale, methods, lessons learned, and potential solutions presented for each step. The six-step process may serve as a guideline for EMS agencies for the creation of local prehospital protocols.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US	The Emergency Medical Services Safety Champions (Patterson, 2013)	American Journal of Medical Quality	EMS staff experience increased risk of poor occupational safety outcomes and negative patient outcomes are associated with the high-risk prehospital setting. There are currently few initiatives that can help achieve improvements to the EMS safety culture as outlined by the National Highway Traffic Safety Administration.
US	The Implementation and Evaluation of an Evidence-based Statewide Prehospital Pain Management Protocol Developed using the National Prehospital Evidence-based Guideline Model Process for Emergency Medical Services (Brown, 2014)	Prehospital Emergency Care	Efforts to increase the rate of pain score documentation and pain medication administration should focus on better defining groups for whom providers withheld analgesics. This approach may improve pain recognition and treatment.
US	The Massachusetts Emergency Medical Service Stroke Quality Improvement Collaborative, 2009–2012 (Daudelin, 2013)	Preventing Chronic Disease	Seventeen Massachusetts EMS agencies collected stroke performance measures on over 3,000 stroke patients. Adherence to 4 of 5 measures increased significantly over time, supporting the continued use of the framework for stroke quality improvement and peer-learning opportunities.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US	The North Carolina EMS Data System: A Comprehensive Integrated Emergency Medical Services Quality Improvement Program (Mears, 2010)	Prehospital Emergency Care	EMS Performance Improvement Toolkits have been developed for the following areas: System Response Time, Acute Trauma Care, Cardiac Arrest Care, Acute Stroke Care, Acute Cardiac (STEMI) Care, and Acute Pediatric Care. The Toolkits link to the state EMS data system and generate a summary report for each EMS agency on the quality and timeliness of their care.
US	The Quality of Prehospital Ischemic Stroke Care: Compliance with Guidelines and Impact on In-hospital Stroke Response (Oostema, 2014)	Journal of Stroke and Cerebrovascular Diseases	The data indicate that improving high priority transportation and hospital pre-notification for suspected stroke cases are promising targets for quality improvement efforts.
US	Variation in the use of 12-lead electrocardiography for patients with chest pain by emergency medical services in North Carolina (Bush, 2013)	Journal of the American Heart Association	Prehospital 12-lead ECG is important for timely STEMI care. Its use remains inconsistent due to limited availability of equipment and EMS staff training levels These barriers to ECG use disproportionately affected health care delivery in rural and underserved areas.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
US, UK, Australia	Measuring quality in emergency medical services: a review of clinical performance indicators (Sayed, 2010)	Emergency Medicine International	Current approaches to measuring quality in health care and EMS with a focus on currently used clinical performance indicators in EMS systems are reviewed. Integration of whole system measures into EMS system evaluation can help overcome some of the challenges of evaluating quality in EMS.
US, Europe, Australia, New Zealand, Canada, Africa	Cardiac Arrest and Cardiopulmonary Resuscitation Outcome Reports: Update of the Utstein Resuscitation Registry Templates for Out-of-Hospital Cardiac Arrest (Perkins, 2014)	Circulation	Previous Utstein templates do not characterize the nature of the organized EMS response, and this report presents template updates that account for EMS system factors. Several subgroups were identified that might estimate the contributions of rhythm and bystander actions, key determinants of patient outcome.
UK	Development and pilot of clinical performance indicators for English ambulance services (Siriwardena, 2009)	British Medical Journal	Twenty ambulance clinical performance indicators in five domains (stroke, STEMI, cardiac arrest, asthma, and hypoglycemia) were developed to assess the appropriateness of specific healthcare decisions, services, and outcomes.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
UK	Development of key performance indicators for prehospital emergency care (Murphy, 2016)	British Medical Journal	A suite of 101 key performance indicators for prehospital emergency care was developed using a Delphi consensus approach. Of the indicators selected, 7 were structure indicators, 74 were process indicators, and 20 were outcome indicators.
UK	The effect of a national quality improvement collaborative on prehospital care for acute myocardial infarction and stroke in England (Siriwardena, 2014)	Implementation Science	The use of care bundles as measures, clinical engagement, application of quality improvement methods, provider prompts, individualized feedback and opportunities for learning led to significant improvements in prehospital care for acute myocardial infarction and stroke.
Asia	Emergency medical services key performance measurement in Asian cities (Rahman, 2015)	International Journal of Emergency Medicine	A comparison of EMS performance parameters based on the structure, process, and outcome analysis is presented in several tables in order to make the case for continuous QI practices across Asia.
Australia	Using a Cardiac Arrest Registry to Measure the Quality of Emergency Medical Service Care: Decade of Findings From the Victorian Ambulance Cardiac Arrest Registry (Nehme, 2015)	Circulation: Cardiovascular Quality and Outcomes	Monitoring of EMS systems of care for out-of-hospital cardiac arrest demonstrated favorable survival outcomes during the 10-year surveillance period.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
Canada	Developing a Canadian emergency medical services research agenda: a baseline study of stakeholder opinions (Dainty, 2013)	Canadian Journal of Emergency Medicine	Perceived barriers to and opportunities for EMS research include: the need for more EMS research education, the need for an infrastructure to support research collaboration, addressing the complexities of EMS provider involvement in research, and considerations for a national research agenda.
Canada	The Canadian National EMS Research Agenda: a mixed methods consensus study (Jensen, 2013)	Canadian Journal of Emergency Medicine	Current barriers to Canadian EMS research include a lack of funding sources, research mentorships, and well-defined data points. EMS data must be valid and reliable within and between EMS systems.
Iran	Challenges of Transferring Burn Victims to Hospitals: Experiences of Emergency Medical Services Personnel (Khankeh, 2016)	Global Journal of Health Science	Data analysis revealed a lack of coordination between Emergency Dispatch Center 115 and EMS personnel for patient admission to hospital, leading to delays in providing specialized care for burn victims. In total, lack of coordination was identified as the most important obstacle to the success of crisis management and provision of care services.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
Netherlands	Improving the governance of patient safety in emergency care: a systematic review of interventions (Hesselink, 2016)	British Medical Journal	Simulation-based training and incident reporting systems with a focus on reducing the fear of reporting, reporting burden, and structural and systematic feedback, are promising interventions to improve the governance of patient safety in emergency care.
Norway	Quality improvement in pre-hospital critical care: increased value through research and publication (Rehn, 2014)	Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine	Optimal QI systems for prehospital care include leadership involvement, multi-disciplinary buy-in, data collection infrastructure, and long-term commitment. Merging process control systems with existing governance systems and intervention methodology promotes quality improvement and the sharing of evidence-based practices.
South Africa	Meeting national response time targets for priority 1 incidents in an urban emergency medical services system in South Africa: More ambulances won't help. (Stein, 2015)	South African Medical Journal	Response time is viewed as a key performance indicator in most emergency medical services (EMS) systems. Based on the data from a simulation model created based on EMS input data, the addition of emergency vehicles to an urban EMS system improves response times in priority 1 incidents, but alone is not capable of the magnitude of response time improvement needed to meet the national response time targets.

GEOGRAPHY	TITLE (first author, year)	SOURCE (journal, other)	SUMMARY
Taiwan	The relationship between survival after out-of-hospital cardiac arrest and process measures for emergency medical service ambulance team performance (Chen, 2015)	Resuscitation	Achieving prehospital ROSC and faster response time were not predictive of the risk-adjusted survival rate at the EMS team level, putting into question the effect of their use in performance evaluation and motivation. Development of EMS team level process measures that are more closely linked to survival may better improve quality performance.

Chapter 5. Summary and Recommendations

In 2012, the California Emergency Medical Services Authority embarked upon an ambitious initiative to routinely collect and analyze statewide EMS performance data that could be used for quality improvement purposes. A set of 17 EMS performance measures was selected to serve as the initiative's Core Measure Set. These measures have remained unchanged over the course of the Project, and an increasing amount of data has been collected on them. All of California's LEMSAs are now contributing data to the EMS Core Measures Project.

We applaud the EMSA's EMS Core Measures Project and commend the EMSA's leadership for undertaking this effort and the successful implementation of the initiative. As would be expected in launching a complex initiative such as this in a state as large and diverse as California, there has been variable local "buy in" to and enthusiasm for the effort and implementation of the Project has not always gone entirely smoothly or moved forward as rapidly as some may have initially hoped.

Based on the results of our survey of LEMSAs described in chapter 2, the review of the annual EMSA Core Measures reports (Chapter 3), the review of the literature (Chapter 4), and the project team's collective expertise, we offer the observations and findings noted below. In considering these findings it should be remembered that this evaluation had a limited scope of work. We are mindful that there may have been factors which influenced the Project, or which will influence its future course, which were beyond the analytic scope of this project.

Observations and Findings

1. The highly diverse nature of California's LEMSAs and the multiple EMS providers that are typically found within the LEMSAs (in many cases more than 10) create significant challenges in collecting and aggregating reliable and timely data for the core measures. These challenges should be able to be substantially mitigated through increased training of EMS personnel about data management, use of standardized prehospital electronic health record (EHR) systems, and enhanced LEMSA data systems.

2. In implementing the Core Measures Project, EMSA's role in facilitating and nurturing quality improvement activities appears not to always have been clear to the LEMSAs and EMS providers. In noting this, we recognize that the EMSA has conducted multiple workshops aimed at promoting understanding of the Core Measures Project and encouraging LEMSAs to use these standardized measures for quality improvement purposes. We are also mindful that regulated communities often have a variety of uncertainties, concerns and fears when regulatory agencies try to lead quality improvement efforts because of the difference in mindsets and approaches, among other things, used when enforcing regulatory compliance and leading quality improvement initiatives. To address these issues, many regulatory agencies partner with

or utilize a non-regulatory entity to conduct quality improvement activities.

3. Most LEMSAs devote few resources to data collection and analysis. Determining the reasons for this was beyond the scope of this project, although we were able to determine that the amount of resources devoted to data management does not necessarily correlate with the size of the LEMSA (in contrast to LEMSA participation in various condition-specific registries where large LEMSAs are more likely to participate in multiple registries).

4. Most LEMSAs report that the lack of accurate reporting from EMS providers and that software and core measure definition challenges are the biggest problems in implementing the Core Measures Project. A large majority of LEMSAs reported that measures which require hospital outcome data are the most difficult ones for which to obtain data.

5. Most LEMSAs report that they do not regularly use the Core Measures Project data for quality improvement purposes. Nearly a third of LEMSAs report that they do not use these data for any purpose other than reporting them to the EMSA. Determining the reasons for this was beyond the scope of this survey, but we find the reported lack of use of these data for their intended purpose to be of concern.

6. A majority of the LEMSAs opined that fewer and more clearly defined and easily captured measures would have been helpful during the initial Project roll out. Of note, we made no assessment of the EMS performance measures selected for use in the Project, nor did we assess how much of an issue the number of core measures which must be reported upon continues to be viewed as problematic; analysis of these things were beyond the scope of this project.

7. Given the variable nature of the data reported in the 2012-2015 Core Measure Project Reports, the use of descriptive statistics would be of unlikely value and was not done in this report. Indeed, statistical analysis of these data could lead to misleading or erroneous conclusions. Without a specific hypothesis about expected performance and level of clinical significance, we believe statistical comparison is not indicated.

RECOMMENDATIONS

Going forward, we believe that the EMSA should build upon the solid foundation it has developed so far, focusing especially on the following four broad areas:

(1) Find ways that to leverage its role as a regulatory agency to stimulate and nurture use of EMS core measure data for quality improvement purposes. Increasing the number of quality improvement training opportunities may be helpful in this regard. We believe the EMSA

should partner with a non-regulatory organization that is experienced in providing education and training to develop and offer quality improvement and other relevant training through use of an array of face-to-face and virtual modalities. It should consider encouraging or facilitating increased training offerings for EMS providers, as well as LEMSAs, which might lead to certification opportunities or other recognitions and awards. The EMSA should routinely review the required quality improvement plans of the LEMSAs for Core Measure-relevant activities and assurance that these elements of the plans are being implemented.

(2) Find ways to normalize and integrate use of EMS core measure data into local quality management activities. It should consider how use of real-time performance "dashboards" might be helpful in this regard. While promoting use of the EMS core measure data for quality improvement purposes should be a shared LEMSA leadership responsibility, in most cases the LEMSA medical director should take the lead in this regard. The LEMSA medical director should have clearly defined roles and responsibilities for doing so in the LEMSA quality improvement plan. The EMSA should provide guidance and support to the LEMSAs and LEMSA medical directors in this regard so that the medical directors are prepared to lead quality improvement strategies and promote best practices across the LEMSAs.

(3) Standardize, streamline and support data collection and processing across local EMS providers and LEMSAs. These efforts should continue to emphasize the critical roles of paramedics and EMTs in collecting data elements that can be used to improve their performance. The recent statutory requirement for the use of standardized national EMS information system data elements and real-time data collection in the field through use of an electronic health record may improve the quality and timeliness of data collection and substantially address current issues in this regard. We recommend that the degree of standardization of data collection and processing across the LEMSAs be formally evaluated after these changes have been materially implemented.

(4) Work with hospital organizations and other relevant groups to facilitate health information exchange between hospitals and EMS providers and LEMSAs. This is especially important to quality improvement efforts in so far as it allows hospital diagnosis and outcome data to be compared with pre-hospital impressions, which will help in the assessment of the utility of individual core measures.

More specifically, we further recommend that the EMSA:

- Consider how it might incentivize LEMSAs and EMS providers, using an array of recognitions and awards, to utilize the EMS Core Measures data for quality improvement purposes.

- Working with the LEMSAs, continue to develop and refine standardized methods for the

collection, aggregation and processing of EMS core measures data by EMS providers and LEMSAs, along with methods to audit compliance with these standardized methods. The EMSA, or its designated representative for quality improvement activities, should promote understanding and use of these standardized data management methods through seminars and conferences, webinars, use of learning aids (e.g., a web-based learning modules), and other methods. Toward this end, the EMSA should develop a standardized core measures data collection process map that details how the data should be obtained, managed or processed, and analyzed to derive reported results. This process map should delineate all material steps from on-site raw data generation to submission of core measure results.

- Evaluate whether the Core Measure Task Force should be continued, expanded or otherwise modified to ensure that it provides an effective vehicle for reviewing the EMS Core Measure Set. In particular, the Task Force should be assessed with regard to whether it includes broad participation from end-users, has sufficient transparency about performance measure criteria and review processes, and is utilizing appropriate methods for adding and retiring individual performance measures. In addition, the EMSA should consider whether the number of core measures reported upon optimizes their value to the LEMSAs and how well the measures are aligned with new national performance measures.

- Consider retiring core measures that have met predefined expected performance levels and develop a process to rotate or introduce new measures into the Core Measures Set. In this regard, we suggest that particular attention be directed to increasing the proportion of outcome measures. We believe a process for retiring and adding measures would facilitate use of core measures to achieve desired practice patterns, and - once goals have been achieved - allow the EMSA to focus on new improvement areas. We recognize that maturation of local or regional health information exchanges and implementation of the new NEMSIS data standards may facilitate this process, and the effects of these developments should be evaluated after the NEMSIS data standards have been implemented.

Appendix A

Appendix A
LEMSA Survey and Detailed Results

Q1. Name of LEMSA

Q2. How many counties are served by your LEMSA?

- ☐ 1
- ☐ 2-5
- ☐ greater than 5

Q3. What are the total number of 911 transports in your LEMSA per year?

Q4. What are the total number of 911 EMS transport providers reporting to your LEMSA? (defined as public/private ALS ambulance service or ALS fire departments transporting for 911 medical dispatches.)

- ☐ 1
- ☐ 2-3
- ☐ 3-5
- ☐ 5-10
- ☐ greater than 10

Q5. How may positions (full time equivalent-FTEs) are dedicated to the operation of your LEMSA?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ greater than 10

Q6. Does your LEMSA have a dedicated Quality Improvement analyst/ data analyst who

creates and runs reports from EMS providers?

- ☐ Yes, we have more than 1 analyst (more than 1 FTE)
- ☐ Yes, we have 1 FTE for analyst
- ☐ Yes, we have less than 1 FTE for analyst
- ☐ No

Q7. For Core Measures your LEMSA has difficulty reporting, what are the most common reasons for the difficulty? (select all that apply)

- ☐ Data not reported by EMS providers/not captured by ePCR
- ☐ Inaccurate data documentation by EMS providers/agencies
- ☐ Other

Q8. In the last 3 years, what have been the greatest logistical challenges facing your LEMSA in participating in Core Measure reporting? (select all that apply)

- ☐ Lack of financial resources
- ☐ Challenges getting complete Core Measure data from EMS providers
- ☐ Software and data dictionary compatibility issues
- ☐ Lack of dedicated staff to support data management
- ☐ Lack of accuracy of EMS data obtained
- ☐ Other

Q9. Does your LEMSA review Core Measure Data to assess current practice within the LEMSA?

- ☐ Yes, on a scheduled basis
- ☐ Yes, occasionally when QI issues arise
- ☐ No

Q10. How has your LEMSA used Core Measure data? (select all that apply)

- Provider practice improvement
- Improving data quality
- Negotiating contacts
- Data collection process improvement
- Compare outcomes with other LEMSAs
- Not currently using data
- Other

Q11. What changes, if any, has your LEMSA made to improve data collection and reporting of Core Measures? (select all that apply)

- Added additional staff
- Upgraded data software and hardware
- Outreach/training to providers
- Request for additional funds
- Required additional training for LEMSA staff
- Formed additional work groups
- No changes
- Other

Q12. What changes would your LEMSA find helpful in the Core Measure project. (select all that apply)

- Fewer Core Measures to track each year.
- Different Core Measures
- Better designed measures
- Increased technical staff support
- Increased guidance from Cal EMSA
- Other

Q13. Are the providers within your LEMSA able to obtain Hospital Outcome data such as Survival to Discharge?

- Almost always
- Occasionally
- Rarely
- Never

Q14. Does your LEMSA participate in any other registries? (select all that apply)

- Trauma registry
- STEMI registry
- Cardiac Arrest registry
- Acute Stroke registry
- Other
- No, we do not participate in any other registry

Appendix B
LEMSA Survey Results

Survey Question	Answer Options	LEMSA Size		
		Small (n=13)	Medium (n=7)	Large (n=11)
Number of counties served	1 county	11	5	8
	2-5 counties	1	2	2
	5 or more counties	1	0	1
Number of 911 EMS transport providers reporting to each LEMSA	1 provider	4	0	0
	2-3 providers	4	4	1
	3-5 providers	2	1	3
	5-10 providers	2	1	1
	10 or more providers	1	1	6
Number of full-time equivalent (FTE) positions dedicated to operating each LEMSA	1 FTE	1	0	0
	2 FTEs	3	0	0
	3 FTEs	2	0	1
	4 FTEs	2	0	0
	5 FTEs	4	1	0
	6 FTEs	1	2	0
	7 FTEs	0	0	2
	8 FTEs	0	0	0
	9 FTEs	0	1	1
	10 or more FTEs	0	3	7
Number of Quality Improvement Analysts / Data Analysts dedicated to creating and running reports from EMS providers	No analysts	5	2	0
	Less than 1 FTE	8	1	4
	1 FTE	0	2	3
	More than 1 FTE	0	2	4

Survey Question	Answer Options	LEMSA Size		
		Small (n=13)	Medium (n=7)	Large (n=11)
Common reasons given for difficulty in reporting Core Measures	Data not reported by EMS providers/not captured by ePCR	7	4	6
	Inaccurate data documentation by EMS providers/agencies	5	3	6
	Other	7	5	7
Greatest logistical challenges facing each LEMSA in participating in Core Measure reporting during the last 3 years	Lack of financial resources	6	1	2
	Challenges getting complete Core Measure data from EMS providers	5	2	7
	Software and data dictionary compatibility issues	7	4	5
	Lack of dedicated staff to support data management	9	3	2
	Lack of accuracy of EMS data obtained	6	3	7
	Other	4	2	2
LEMSA review of Core Measure Data to assess current LEMSA practice	Done on a scheduled basis	5	3	4
	Done occasionally when QI issues arise	4	2	4
	Review not performed	4	2	3

Survey Question	Answer Options	LEMSA Size		
		Small (n=13)	Medium (n=7)	Large (n=11)
Ways in which Core Measure data were used (multiple answers selected)	Provider practice improvement	7	3	7
	Improving data quality	4	4	7
	Negotiating contacts	1	1	0
	Data collection process improvement	5	5	6
	Compare outcomes with other LEMSAs	6	0	2
	Not currently using data	4	1	4
	Other	1	1	0
Changes made by each LEMSA to improve data collection and reporting of Core Measures (multiple answers selected)	Added additional staff	2	2	0
	Upgraded data software and hardware	3	4	6
	Outreach/training to providers	4	5	4
	Request for additional funds	3	2	1
	Required additional training for LEMSA staff	1	3	2
	Formed additional work groups	2	2	2
	No changes were made	3	1	3
	Other	5	0	3

Survey Question	Answer Options	LEMSA Size		
		Small (n=13)	Medium (n=7)	Large (n=11)
Changes to the Core Measure project that would be helpful to the LEMSAs (multiple answers selected)	Fewer Core Measures to track each year	5	1	5
	Different Core Measures	1	1	2
	Better designed measures	7	6	10
	Increased technical staff support	5	4	3
	Increased guidance from Cal EMSA	5	3	4
	Other	3	1	1
Ability of providers within each LEMSA to obtain Hospital Outcome data, such as Survival to Discharge	Almost always able	3	1	0
	Occasionally able	3	3	4
	Rarely able	5	2	2
	Never able	1	1	5
Registries in which each LEMSA participates (multiple answers selected)	Trauma registry	8	7	10
	STEMI registry	1	5	6
	Cardiac Arrest registry	1	5	2
	Acute Stroke registry	0	4	7
	Other	0	0	0
	No, we do not participate in any other registry	4	0	0

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