Summary of Findings and Recommendations

For
California Emergency Medical Services Authority

April 2013

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Overview

The California Emergency Medical Services Authority (EMSA) is responsible for overseeing and coordinating emergency medical services (EMS) throughout the State of California. One of the requirements of EMSA is to collect and evaluate data. Currently, Local Emergency Medical Services Agencies (LEMSAs) submit their EMS call data to the California Emergency Medical Services Information System (CEMSIS) on a voluntary basis. LEMSAs collect EMS data elements as described by the CEMSIS data dictionary. These elements describe a complete EMS event. EMSA contracts with a local agency to receive and process the data, and EMSA staff access the information through a business intelligence (BI) application. One of EMSA's goals is to use these data to calculate and publish results on a set of core measures that "…describe the coordination and effectiveness of EMS utilizing regional and local information for California."[1] Table 1 presents a list of the core measures identified by EMSA. The core measures are based on evidence-based practices that are known to improve care and result in better outcomes.

Table 1—EMS System Core Measures for California		
Core Measure Set	Measure ID	Performance Measure Name
Trauma	TRA-1	Scene time for severely injured trauma patients
	TRA-2	Direct transport to trauma center for severely injured trauma patients meeting criteria
Acute Coronary Syndrome	ACS-1	Aspirin administration for chest pain/discomfort
	ACS-2	12 lead EKG performance
	ACS-3	Scene time for suspected heart attack patients
	ACS-4	Advance hospital notification for suspected acute coronary syndrome
	ACS-5	Direct transport to PCI center for suspected ACS patients meeting criteria
Cardiac Arrest	CAR-1	AED application prior to EMS arrival
	CAR-2	Out-of-hospital cardiac arrests return of spontaneous circulation
	CAR-3	Out-of-hospital cardiac arrests survival to emergency department discharge
	CAR-4	Out-of-hospital cardiac arrests survival to hospital discharge
Stroke	STR-1	Identification of suspected stroke in the filed
	STR-2	Glucose testing for suspected stroke patients
	STR-3	Scene time for suspected stroke patients
	STR-4	Advance hospital notification for suspected stroke
	STR-5	Direct transport to stroke center for suspected stroke patients meeting criteria
Respiratory	RES-1	CPAP given for patients with respiratory distress
	RES-2	Beta2 agonist administration
Pediatric	PED-1	Pediatric asthma patients receiving bronchodilators
	PED-2	Transport to pediatric trauma center
Pain Intervention	PAI-1	Pain intervention
	PAI-2	Results of pain intervention
Performance of Skills	SKL-1	Endotracheal intubation success rate
	SKL-2	End-tidal CO2 performed for any successful endotracheal intubation
Response and Transport	RST-1	Ambulance response time by ambulance zone (Emergency)
	RST-2	Ambulance response time by ambulance zone (Non-Emergency)
	RST-3	Transport of patients to hospital
Cardiopulmonary Resuscitation	PUB-1	Out-of-hospital cardiac arrest receiving bystander (non-EMS personnel/responder) CPR

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[1] California Emergency Medical Services Authority. EMS Core Quality Measure Project. http://www.emsa.ca.gov/systems/ Core_Measures.asp. Accessed on: March 21, 2013.

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One of EMSA's first steps in carrying out this goal was to perform an assessment of the data systems to identify data quality concerns. As part of the CEMSIS Data Profile and Evaluation contract, EMSA tasked Health Services Advisory Group, Inc. (HSAG) with performing an evaluation of the CEMSIS-EMS data. HSAG worked with EMSA to design three sets of reports, based on stated project goals, to evaluate these data:

◆ **Report Set 1**—This report presented data quality results from examining the LEMSA source data (i.e., raw data) from calendar year 2009 through 2012. The evaluation of these data included verifying, where applicable, that values matched the EMS Data Systems Standards (i.e., ensured that values matched those in the data dictionary), an evaluation of missing and unusable data, and a check that appropriate predecessor logic was followed.

◆ **Report Set 2**—This report presented data quality results from examining the LEMSA source data (i.e., raw data) from calendar year 2009 through 2012. After reviewing Report Set #1, EMSA wanted to drill down further into only a handful of data elements. The report focused on four data elements: Procedure, Medication Given, Prior Aid, and Age. The values for each data element were compared to related fields, as identified by EMSA.

◆ **Report Set 3**—This report presented data quality results from examining data pulled from the CEMSIS report data for calendar year 2009 through 2011. The report focused on the same four data elements as Report Set #2: Procedure, Medication Given, Prior Aid, and Age. The values for each data element were compared to related fields, as identified by EMSA. This report was designed to show EMSA the differences in the data between the LEMSA source data and the CEMSIS report data.

The findings of these reports revealed the following limitations in the ability of EMSA to calculate the core measures:

◆ **Incomplete Reporting**—approximately half of the LEMSAs are not reporting data to EMSA; therefore, the results would be less meaningful since results would be limited to those LEMSAs that submitted data.

◆ **CEMSIS Report Data**—the CEMSIS report data have fewer records than the LEMSA source data. Based on these preliminary findings, the CEMSIS reporting system may not support the reporting needs of EMSA for purposes of calculating core measures since data may be getting lost and incorrectly translated as it is processed and moves through the system.

Data Findings

While it is understood that EMSA will use the CEMSIS report system to calculate the core measures, it also was import to evaluate the completeness, validity, and usability of the LEMSA source data since the quality of the data coming out of the CEMSIS report system is reliant on the quality of the LEMSA source data. In general, most of the data elements used to calculate the core measures did not contain a substantial percentage of invalid data. However, several data elements used to calculate the core measures contain a high percentage of values that cannot be used for measure calculation (i.e., values are not available, not known, not reporting, not recorded, not applicable, or missing); therefore, the number of records that can be used for measure calculation will be limited.[2] EMSA should perform further analyses to determine the impact these records have on measure calculation.

LEMSA Participation

Just over half of the LEMSAs submitted data to CEMSIS in 2009, 2010, 2011, or 2012. However, the number of participating provider agencies differs by year and LEMSA. Table 2 provides a summary of the number of provider agencies that submitted records by year and LEMSA.[3]

Table 2—Number of Providers Agencies that Submitted Records				
LEMSA	**Number of Provider Agencies**			
	2009	**2010**	**2011**	**2012**
Alameda	—	—	—	—
Contra Costa	1	1	1	—
El Dorado	—	—	—	—
Imperial	—	—	—	—
Kern	—	—	—	—
Los Angeles	—	81	—	—
Marin	—	10	10	—
Merced	1	2	2	—
Monterey	1	2	2	1
Napa	—	—	—	—
Orange	—	13	13	—
Riverside	—	3	3	5
Sacramento	—	—	—	—
San Benito	1	2	2	1
San Diego	—	—	—	—
San Francisco	—	—	—	—
San Joaquin	—	—	—	—

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[2] Please see Report Set #1 and Report Set #2 for further details on LEMSA source data findings at the data element level.
[3] The numbers in this table were derived from a review of the raw data.

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Table 2—Number of Providers Agencies that Submitted Records				
LEMSA	**Number of Provider Agencies**			
	2009	**2010**	**2011**	**2012**
San Luis Obispo	—	2	2	—
San Mateo	—	—	—	—
Santa Barbara	—	—	—	—
Santa Clara	2	3	2	—
Santa Cruz	—	—	—	—
Solano	—	—	—	—
Tuolumne	—	—	—	—
Ventura	—	—	—	15
Mountain Valley	1	4	5	1
Central California	—	11	10	—
Inland Counties	—	—	—	—
North Coast	—	9	12	—
Northern California	21	24	9	—
Sierra-Sacramento Valley	—	1	1	—
Coastal Valleys	—	2	—	—
— indicates that no data were submitted during the year.				

Given that nearly half of the LEMSAs are not reporting data, results will likely be biased when comparing measure performance on the core measures across the state. Bias can underestimate or overestimate true results. The following sources of bias should be considered and addressed by EMSA prior to measure calculation:

♦ **Reporting bias**—can occur when unexpected or undesirable data are selectively suppressed.

♦ **Coverage bias**—can occur when there is a difference in results between those who do and do not report data.

In addition, the lack of reporting across all LEMSAs limits EMSAs ability to determine the coordination and effectiveness of EMS across the entire state.

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LEMSA Source Data vs. CEMSIS Report Data

In general, the number of records in the CEMSIS report data was substantially lower than the number of records observed in the LEMSA source data. Table 3 provides a comparison of the number of records identified for each LEMSA by year in the LEMSA source data versus the CEMSIS report data.

Table 3—Number of Records Comparison						
LEMSA	2009		2010		2011	
	Records in LEMSA Source Data	Records in CEMSIS Report Data	Records in LEMSA Source Data	Records in CEMSIS Report Data	Records in LEMSA Source Data	Records in CEMSIS Report Data
Contra Costa	42	44	74,562	73,954	100,432	99,625
Los Angeles	—	—	547,770	335,476	—	—
Marin	—	—	28,914	14,479	18,485	14,953
Merced	26,551	21,084	23,348	23,059	13,996	13,957
Monterey	4	4	20,763	14,869	31,117	26,267
Orange	—	—	63,699	54,904	13,196	13,196
Riverside	—	—	884	879	11,997	11,377
San Benito	1	0	3,766	1,459	2,555	2,153
San Luis Obispo	—	—	18,804	18,804	23,412	18,928
Santa Clara	153	75	147,530	76,016	43,620	27,234
Mountain Valley	1	1	63	57	39,126	62,580
Central California	—	—	138,246	140,616	40,352	41,168
North Coast	—	—	19,772	11,285	20,182	15,850
Northern California	18,661	16,837	23,810	21,726	2,223	2,223
Sierra-Sacramento Valley	—	—	2,373	0	817	14,106
Coastal Valleys	—	—	2	0	—	—
— indicates that no data were submitted during the year.						

In reviewing the CEMSIS report data tables (i.e., the tables that link to the BI application), this level of discrepancy was not identified. There appears to be additional filters that limit the data when it is extracted through the CEMSIS reporting system. Furthermore, it is known that additional transformation of the data is being performed. For example, the following values were not identified in the CEMSIS report data: -25, -20, -15, -10, and -5. Instead values of "*NA" and "*ND" appeared to replace these values. Further information is needed on how the CEMSIS reporting system processes, filters, and transposes the data. EMSA should request this information from its vendor.

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Based on preliminary findings, the CEMSIS reporting system may not support the reporting needs of EMSA for purposes of calculating core measures since data may be getting lost and incorrectly translated as it is processed and moves through the system.

Core Measures

The EMS core measures are standardized performance measures or quality indicators that are used to examine the EMS system. EMSA has identified 28 core measures within 10 measure sets. These core measures will begin to benchmark the performance of EMS systems and will help EMS systems improve the quality of patient care by focusing on the actual results of care.[4]

One of the data elements that was evaluated from the CEMSIS report data was age. Age is an important element since it is used in 21 of the core measures. For 2009, 2010, 2011, and 2012, approximately 10 percent of the records from the LEMSA source data included invalid or missing date of birth and unit type; therefore, the patient's age could not be determined for these records (i.e., 10 percent of the records from the LEMSA source data could not be in those 21 measures). Furthermore, the age data generated from the CEMSIS report data has duplicate records. In some cases, a single record had different values for the variables (i.e., there were two rows for one record; however, the age information was different in the two rows). In addition, the age derived from the date of birth does not always match the age when combined with units. This was identified mostly in the adult population and occurred in approximately 5 percent of records in the CEMSIS report data. Given the level of missing and disparate data, the age data element may have material bias on the results. However, further analysis should be performed to identify which of the patients would qualify for each measure (using the other data elements) and the potential implication missing or invalid age data may have on the measures (i.e., the level of bias should be assessed). Typically an error in the data causing a +/- 5 percentage point difference in the reported rate is considered materially biased.

In addition to age, HSAG evaluated the following data elements from the CEMSIS report data: Procedure, Medications, and Prior Aid. Invalid values were included in the data; therefore, EMSA would need to be able to identify these, where applicable. HSAG did not identify any other substantial issues with these data elements specific to the CEMSIS report data.

HSAG was unable to evaluate all the data elements using the CEMSIS report data or how the system works as a whole; therefore, EMSA, or its contractor, will need to perform further analyses on the additional core measure data elements to identify whether the CEMSIS report data will support the calculation of these measures. The following provides HSAG's preliminary findings on the ability to report on each measure set using the CEMSIS report data.

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[4] California EMS System Core Quality Measures. Emergency Medical Services Authority California Health and Human Services Agency. January 2013.

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Trauma Measures

Based on the findings of the Age variable, HSAG has concerns with EMSA's ability to calculate valid results from the CEMSIS report data. Further analyses need to be performed on the trauma core measures data elements using the CEMSIS report data.

Acute Coronary Syndrome Measures

Measures in this measurement set require the use of the procedures and medications given data elements. All of the procedures and medications listed in the methods for this measure set were included in the CEMSIS report data. Based on the findings of the age variable, however, HSAG has concerns with EMSA's ability to calculate valid results from the CEMSIS report data. Further analyses need to be performed on the acute coronary syndrome measures data elements using the CEMSIS report data.

Cardiac Arrest Measures

Measures in this measurement set require the use of the prior aid performed by data elements. All of the prior aid performed by codes listed in the methods for this measure set were included in the CEMSIS report data; however, these values account for less than 1 percent of the data. Therefore, there may be limited utility for this data element. Furthermore, based on the findings of the Age variable, HSAG has concerns with EMSA's ability to calculate valid results from the CEMSIS report data. Further analyses need to be performed on the cardiac arrest measures data elements using the CEMSIS report data.

Stroke Measures

A measure in this measurement set requires the use of the procedure data element. The procedure listed in the methods for this measure set was included in the CEMSIS report data. However, based on the findings of the age variable, HSAG has concerns with EMSA's ability to calculate valid results from the CEMSIS report data. Further analyses need to be performed on the stroke measures data elements using the CEMSIS report data.

Respiratory Measures

Measures in this measurement set require the use of the medications given and procedures data elements. Two of the three medication codes listed in the methods for this measure set were included in the CEMSIS report data. Code 8635 was missing from both the LEMSA source data and the CEMSIS report data. This may be an indication of underreporting for this data element. Furthermore, based on the findings of the age variable, HSAG has concerns with EMSA's ability to calculate valid results from the CEMSIS report data. Further analyses need to be performed on the respiratory measures data elements using the CEMSIS report data.

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Pediatric Measures

Measures in this measurement set require the use of the medications given and procedures data elements. Two of the three medication codes listed in the methods for this measure set were included in the CEMSIS report data. Code 8635 was missing from both the LEMSA source data and the CEMSIS report data. This may be an indication of underreporting for this data element. Furthermore, based on the findings of the Age variable, HSAG has concerns with EMSA's ability to calculate valid results from the CEMSIS report data. In addition, only about 7 percent of the records are for children 14 and under. Further analyses need to be performed on the pediatric measures data elements using the CEMSIS report data.

Pain Intervention Measures

Measures in this measurement set require the use of the medications given and procedures data elements. The measures require that at least one value representing an accepted intervention for pain relief be populated for either data element; however, the methods do not specify specifically which medications or procedures these would be. EMSA would need to identify which medications and procedures meet these criteria in the CEMSIS report data. If EMSA will use any valid value as an acceptable procedure, EMSA will need to be able to identify those values that are invalid since both data elements included invalid values in the CEMSIS report data. Furthermore, based on the findings of the Age variable, HSAG has concerns with EMSA's ability to calculate valid results from the CEMSIS report data. Further analyses need to be performed on the pain intervention measures data elements using the CEMSIS report data.

Performance of Skills Measures

Measures in this measurement set require the use of the procedures, number of procedure attempts, and procedure successful data elements. All of the procedures listed in the methods for this measure set were included in the CEMSIS report data. In addition, the Number of Procedure Attempts and the Procedure Successful data elements are being reported for most procedures. Based on the data provided, EMSA may be able to calculate the results for these measures from the CEMSIS report data.

Response and Transport Measures

None of the data elements for this measures set were evaluated by HSAG from the CEMSIS report data. Analyses need to be performed on the response and transport measures data elements using the CEMSIS report data.

Cardiopulmonary Resuscitation Measure

The measure in this measurement set requires the use of the prior aid performed by data element. The prior aid performed by code listed in the methods for this measure set was included in the CEMSIS report data; however, this value accounts for less than 1 percent of the data.

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Therefore, there may be limited utility for this data element. Further analyses need to be performed on the cardiopulmonary resuscitation measure data elements using the CEMSIS report data.

Recommendations

The following are recommendations for EMSA to move forward with the core measures project:

1. HSAG recommends that EMSA investigate why there are fewer records coming from the CEMSIS report data than the LEMSA source data. This finding is one of HSAG's biggest concerns with EMSA's ability to use the CEMSIS report data to calculate the core measures. EMSA will need to perform additional research and learn more about their current system to determine if the system is appropriately filtering and transforming data. EMSA can work with its current vendor to obtain any documentation that will give them more information about the system (e.g., business rules, table relationships). This step should be performed prior to any further analyses of the data elements to ensure the CEMSIS report data are complete and accurate.

2. EMSA should work with local agency administrators to achieve success in mandating data submission and required fields. One of the limitations identified were that approximately half of the LEMSAs were not reporting data. This limits EMSAs ability to provide regional- and state-level oversight.

3. HSAG was only able to evaluate a limited number of data elements directly from the CEMSIS reporting system. Therefore, EMSA should perform further analyses to determine whether the additional data elements required for reporting the core measures can be evaluated using the CEMSIS report data and whether the data are useable to provide regional- or state-level oversight.

4. EMSA should work with the LEMSAs to improve data quality and collaboration. This could include a process for checking the data that are coming into the system from the LEMSAs. EMSA can perform error checks on certain fields and generate a report providing feedback on whether the file was accepted or rejected (and reasons for the file being rejected). Examples of checks that should be performed are:

   ♦ Where applicable, data elements should be validated against values in the data dictionary.
   ♦ Check to ensure that dates and times are provided in appropriate formats (e.g., MMDDYYYY).
   ♦ Predecessor logic should be evaluated to ensure that data elements are only completed when the predecessor variable has a valid value for completion.
   ♦ For data elements that do not accept null values, ensure that the data element is populated with a value (i.e., establish mandatory data fields).
   ♦ For paired data elements that accept multiple entries, check that the number of entries is consistent across data elements.

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