EVALUATING STATE CAPACITY TO COLLECT AND ANALYZE EMERGENCY MEDICAL SERVICES DATA

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ABSTRACT

Background. Centralized emergency medical services (EMS) data collection is critical to evaluating EMS system effectiveness, yet a general lack of EMS data persists at local, state, and national levels. Objective. To assess state capacity to collect, analyze, and utilize EMS data. Methods. Information was gathered through state site visits and surveys from 54 states and U.S. territories in spring 2003 regarding EMS data-collection systems. Survey results were used to create 11 broad indicators that assess state data system infrastructure, collection methods, compliance with data standards, and data uses. Results. States and territories on average met 59% of the EMS data system indicators, with four states meeting all 11 indicators and two states meeting none. Seventy-six percent of the states reported having state-level EMS data collection systems, and 78% reported having authority to collect EMS data. However, most state EMS data sets were not capturing information on all EMS incidents, and only 46% of the states had data dictionaries containing at least three-fourths of nationally recommended EMS data elements. In addition, only 33% of the states had linked EMS data with other health data sets to analyze EMS system operations and patient outcomes. Conclusion. While EMS data systems exist in the majority of states, continued attention and resources are needed for state-level EMS data system development to improve capacity for evaluation of emergency medical services. Key words: emergency medical services; standards; communication systems; data collection; states; data systems.

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Prehospital emergency medical services are a component of the health care system that delivers initial emergency response and treatment to ill or injured people, as well as transportation of those individuals to appropriate medical facilities when needed. Accurate information is needed to systematically understand the effectiveness of care provided, assess national preparedness for bioterrorism or other disasters, and identify interventions and strategies to improve quality of care and optimize patient outcomes.1–4

The need for centralized data-collection in emergency medical services (EMS) is well documented.1–5,7–15 An EMS data system allows key personnel to evaluate system effectiveness, enhance service quality, conduct research, and promote efficient resource allocation.2 Information systems should be capable of producing uniform, valid, and comprehensive data that are linkable with other data sets and that are made available to EMS provider agencies.3 Standard EMS data elements with corresponding definitions have been developed by the National Highway Traffic Safety Administration (NHTSA) and have been encouraged for adoption in state systems to promote uniformity in data collection and to allow for comparative analyses within and across states.13 Activities in the last several years have focused on establishing a national EMS database to address issues of national importance in the EMS profession and to promote better collection methods and more standardized use of data sets at the state level.1

Despite the acknowledged importance of EMS data-collection, EMS data are generally lacking at local, state, and national levels.1–5,7–10,12,15,16,17 Mears et al. described this concern by stating that “embarrassingly, data at all levels [of the EMS system] are typically inadequate even to describe EMS as a profession.”1 In 2001, the United States General Accounting Office (GAO) released a study of local and state EMS systems, which emphasized that EMS data are simply lacking at local, state, and national levels for system evaluation and performance improvement purposes.10

While both the need for and the lack of quality data in EMS have been amply observed, little effort has been made to systematically assess key aspects of state data-system capacity. A 1995 study conducted through an NHTSA technical assessment analyzed ten essential components of state EMS systems, which included issues regarding data collection. However, the study did not present or describe in-depth information about state data-system capabilities.12 A 2004 study focused specifically on state EMS data element compliance with national data standards, but did not evaluate other aspects.
of data systems. The objective of our study was to gather broader information from states and review several key indicators of state capacity to collect, analyze, and use EMS data.

**METHODS**

**Study Design**

This study was reviewed and approved by the University of Utah Institutional Review Board. We surveyed personnel in the EMS regulatory office in each of the 50 states, the District of Columbia, and five U.S. territories (hereafter referred to collectively as “states”) to capture information about state EMS data-system capabilities. A 61-question survey instrument focused on general components of state EMS systems, local EMS agency data-collection methods, state data-collection characteristics, and state EMS data analysis and reporting capabilities.

The surveys were conducted from March 2001 through January 2003 during state site visit interviews or through e-mailing the survey tool to appropriate state EMS personnel. Site visits were the preferred method because they allowed study personnel to gather detailed information and directly observe features and capabilities of each state’s EMS data-collection system, such as computer entry screens, system navigation features and logic, data-verification capabilities, and system reporting features. When site visits could not be arranged, we e-mailed the survey instrument to contacts in each state EMS office with telephone follow-up. In spring 2003, survey responses from the database were returned to each state contact for verification and updating to ensure data accuracy and to standardize the timing of survey information.

**Respondent Characteristics**

To make information gathering from site visits as comprehensive as possible, we included several local individuals in the survey process who were familiar with the state’s current data system as well as any future development plans. Participants at the site visits typically included the state EMS director, the EMS for Children (EMSC) project coordinator, EMS and trauma registry managers and analysts, and quality improvement managers. For states that were not visited, e-mail surveys were sent to the EMSC project coordinator or other designated EMS personnel to coordinate the gathering of information and the return of survey responses.

**Measurements and Analysis**

Once the collection and verification of survey data were completed, survey questions and responses were used by the authors to identify 11 key indicators of a state EMS agency’s data-collection and management capabilities. This review of system indicators is similar to the model developed by West et al. to evaluate state trauma system capabilities. The indicators identified generally describe EMS data-system components including data-system infrastructure (existence of a state data system and authority to collect data); data-collection volume and methods (types and percentages of incidents for which data are collected and percentage of information collected electronically); data standards and quality (review of the accuracy of received data and adherence to the NHTSA-recommended EMS data element standard); and data uses (existence of data analysis, reporting, and linkage activities). All indicators were dichotomized so that states either met or did not meet each individual indicator. Certain indicators were further analyzed to show ranges of responses from states.

Analyses were performed to evaluate the reliability and external validity of the indicators. A Cronbach’s alpha reliability score was used to determine the degree of internal consistency among the indicators. To assess external validity, a Spearman’s rho correlation coefficient was used to associate indicator results for each state with other attributes thought to correlate with EMS data-system development. These attributes were 1) the respondent’s perceived adequacy of state EMS data-system funding, 2) the existence of other state databases such as motor vehicle crash, trauma, and hospital inpatient databases, and 3) the existence of an EMS quality improvement program in the state. All analyses were conducted using SPSS, version 12.0 (SPSS Inc., Chicago, IL) and were considered statistically significant at p < 0.05.

**RESULTS**

**Response Characteristics**

We obtained survey information from 54 of the 56 (96%) states. This was accomplished through site visit interviews for 41 states. We e-mailed the survey to the remaining 15 states where site visits could not be arranged, and 13 completed and returned the survey by fax or e-mail. The 54 responding states provided answers to nearly all survey questions, with no questions being systematically skipped or omitted.

**Reliability and Validity Analysis**

The Cronbach’s alpha reliability analysis resulted in a score of 0.85, indicating that the internal consistency or “cohesiveness” among the indicators is moderate to high, and that the indicators work reasonably well together in measuring data-system capacity. In measuring external validity, a Spearman’s rho correlation demonstrated modest relationships between the summary score for each state and the respondent’s
TABLE 1. Number and Percentage of States Fulfilling Each of the 11 Key Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>All Survey Respondents (N = 54)</th>
<th>States with Data-collection systems (N = 41)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the state have a system in place to collect data from local EMS providers?</td>
<td>41 76</td>
<td>—</td>
</tr>
<tr>
<td>2. Does the state have legal authority to require providers to submit EMS data?</td>
<td>42 78</td>
<td>38 93</td>
</tr>
<tr>
<td>3. Does the state collect data on all types of EMS incidents?</td>
<td>36 67</td>
<td>36 88</td>
</tr>
<tr>
<td>4. Does the state collect data for at least 75% of all EMS incidents estimated to occur in the state?</td>
<td>24 44</td>
<td>24 59</td>
</tr>
<tr>
<td>5. Does the state capture at least 50% of the EMS incident data collected from providers electronically?</td>
<td>26 48</td>
<td>26 63</td>
</tr>
<tr>
<td>6. Does the state conduct some type of quality assurance check of the data submitted by EMS providers?</td>
<td>33 61</td>
<td>33 81</td>
</tr>
<tr>
<td>7. Does the state have a data dictionary containing at least 75% of the data variables recommended by the NHTSA 1.0 EMS data set?</td>
<td>25 46</td>
<td>19 46</td>
</tr>
<tr>
<td>8. Does the state conduct analyses of the EMS data collected?</td>
<td>41 76</td>
<td>40 98</td>
</tr>
<tr>
<td>9. Does the state produce EMS reports based on data collected?</td>
<td>37 69</td>
<td>36 88</td>
</tr>
<tr>
<td>10. Does the state have the capability to link EMS data to other health care data sets?</td>
<td>30 56</td>
<td>25 61</td>
</tr>
<tr>
<td>11. Has the state conducted data linkages?</td>
<td>18 33</td>
<td>17 42</td>
</tr>
</tbody>
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EMS = emergency medical services; NHTSA = National Highway Traffic Safety Administration.

perceived adequacy of state EMS data-system funding (rho = 0.33, p = 0.02), the existence of other state databases (rho = 0.24, p = 0.08), and the existence of a state EMS quality improvement program (rho = 0.23, p = 0.11).

Analysis of State EMS Data System Indicators

The percentage of states fulfilling each of the 11 indicators is shown in Table 1. Results ranged from a

Maps Not to Scale

- 0 – 3 indicators met (12)
- 4 – 7 indicators met (14)
- 8 – 11 indicators met (28)
- No survey returned (2)

FIGURE 1. Map of states and territories showing the numbers of indicators of emergency medical services data-system development met.
high of 78% of states having authority to require submission of EMS data to a low of 33% of states that have conducted data linkage. As shown in Figure 1, 28 states met eight or more indicators (52%), 14 states met four to seven indicators (26%), and 12 states met three or fewer indicators (22%). Collectively, the states met about six of the 11 indicators. Four states met all 11 indicators (7%), and two states did not meet any of the indicators (4%).

Analysis of the 41 states with data systems shows that 24 were collecting data for 75% or more of their EMS incidents, with 18 estimating that they collected data on all of the EMS incidents in the state. Conversely, 11 states were collecting data on fewer than 25% of the incidents in the state, with five collecting data on less than 10% of the incidents (Figure 2). Similarly, 23 of the 41 states collected data electronically from providers for 75% or more of the state EMS incidents, while 12 collected data electronically on 25% or fewer of the EMS incidents (Figure 3).

**DISCUSSION**

In this study, we assessed state-level capacity to collect, analyze, and use EMS data. Our results show that a majority of states have an infrastructure for the collection of EMS data. However, state data-collection is often incomplete and is only partially in compliance with national standards, and few states are linking EMS data to other data sources for use in the assessment of patient outcomes.

Our findings suggest a number of strengths among state EMS data systems. First, data-collection is an identified priority, as evidenced by the relatively high percentage of states collecting EMS data (76%). In addition to the 41 states collecting data, another 12 states indicated they were in the process of developing a system to collect EMS data. Similarly, more than three-fourths of all states have authority to collect or require submission of EMS data by providers, indicating a recognition of the importance of data for public health surveillance. Finally, three-fourths of all states are performing data analyses, and nearly as many are producing reports based on submitted data such as annual and quarterly reports, quality improvement reports, and other reports by request. These percentages are even higher when calculated for just the 41 states that have data-collection systems. Analysis and dissemination of data are critical components of an effective EMS information system, providing a mechanism to identify and communicate
strengths and weaknesses in the delivery of EMS care and driving system improvement.1,3,10

Additional discussions during site visits revealed that many states recognize electronic data-collection as a preferred method of gathering information over paper-based systems. While most states do not have complete electronic data-collection systems, many are trying to develop more efficient electronic methods for collecting and reporting data. This advance toward electronic systems will allow states to increase the timeliness of the information reported and reduce the manual entry of data at the state level that is common with paper-based systems.

Study findings also show that certain aspects of EMS data-collection systems need improvement. First, only 18 of the 41 states collecting data estimate they are doing so for all of the EMS incidents in the state. This means that the majority of states do not have a complete data set, limiting the generalizability of what data are captured, especially if the data are selectively missing for particular types of EMS providers (e.g., rural vs. urban, volunteer vs. paid, basic life support agencies vs. advanced life support agencies). Second, only 33% of all states have linked EMS data with other data sets. Data linkage allows analysts to track individual incidents through multiple data sets, including dispatch, motor vehicle crash, EMS, emergency department, and hospital inpatient files, which is integral for evaluation of the effect of EMS provider practice on patient care and short- and long-term patient outcomes.2 Among those states with actual linkage capability (meaning they have an EMS data-collection system, data linkage software, and other state health care databases to link to), one-third have not linked EMS data to other data sets, which limits their ability to track patient outcomes.

Another deficiency is that the use of an established national EMS data standard does not appear to be widespread or uniform, with only 46% of all states having a data dictionary that contains at least three-fourths of the NHTSA 1.0 recommended EMS data elements. Having dissimilar data elements compromises the ability to analyze EMS data within and across states to compare system performance and identify best practices.2,3,15,21 As part of activities associated with the National EMS Information Systems project (NEMSIS), the list of uniform data elements has recently been revised. The new, more robust data set (version 2.2) is complete with a data schema and XML language designed to ensure that different database applications will record and transfer data in the same format.22 As of
April 2005, 54 states had signed an agreement to use the new data set and promote its implementation. As substantially more planning, testing, and technical assistance resources are being devoted to this new data set, state compliance with national data standards should improve in the coming years.

Additional discussion during site visits also indicated that barriers exist to data-system development and to obtaining full data-submission compliance from EMS providers. These barriers were largely financial (lack of dedicated funding and staffing), technical (difficulty exporting data between different formats and outdated software), and political (concern over greater perceived state regulation and fear of the use of data for punitive purposes). Of these, the lack of financial resources for data system development and maintenance was the most frequently cited barrier.

In addition, while many states have authority to collect data from providers, several indicated they lack the ability or are unwilling to strictly enforce the data-submission requirement for fear of causing undue burden on providers (especially volunteer EMS services with minimal resources) or leaving a community without EMS services through revocation of license. Therefore, many states describe having limited power to enforce data-submission compliance, which will likely remain a challenge to complete EMS data-collection in the future.

LIMITATIONS AND FUTURE STUDIES

There are limitations associated with our study that should be mentioned. Our collection of information by both site visit and e-mail survey may have resulted in differing levels of information received; responses to questions in the e-mail survey, for instance, may have been less descriptive or detailed than those gathered through site visit. Also, the current 11 indicators allow for basic measurement of EMS data-system capability, but they are limited in their ability to describe how data are being used to evaluate patient care and drive quality improvement in state EMS systems, which are key reasons for the collection of data. For future analyses, these indicators will likely need to be modified to better assess how data are used to evaluate and improve the overall delivery of care in the EMS system. Finally, the data in this study are as of spring 2003, and do not reflect any data-system advancements or changes that may have occurred in states since that time. However, we believe the information is still important because it represents a snapshot of data-system capacity in time and allows states the ability to benchmark and track system progress in the future.

CONCLUSION

This study is unique in that it attempted to systematically evaluate and quantify the status of state EMS data-systems using broad indicators of data-system capacity gathered primarily through state site visits. Our findings show that most states are collecting EMS data or are in the process of developing such capability. However, continued attention and resources are needed to develop quality state-level EMS data-systems that collect timely, uniform data and allow for thorough evaluation of prehospital care practices.

The authors express their thanks and appreciation to each of the states and U.S. territories that participated in the process of providing information regarding state EMS data systems.

References