Beyond EMS Data Collection: Envisioning an Information-Driven Future for Emergency Medical Services

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16. Abstract *Beyond EMS Data Collection: Envisioning an Information-Driven Future* is the result of 10 months of work and study by a committee formed by the NHTSA Office of EMS to lend its expertise to the issue of data and information use in EMS. The summit meeting was held in July 2016. Nearly 50 participants representing a variety of national EMS organizations joined the committee in discussing the current state of data use in EMS and ways in which it might be improved. The goal of the summit was to envision a future in which EMS at all levels is inspired to collect and use data to drive meaningful change, and identify tactics for realizing such a future. This document summarizes the findings of the committee as well as discussions at the summit meeting. It is not a consensus document. Rather, it is intended to provide feedback to the EMS community on the issues, to provide guidance to EMS leaders, and to provide valuable information for the revision of relevant sections of the 1996 EMS Agenda for the Future.			
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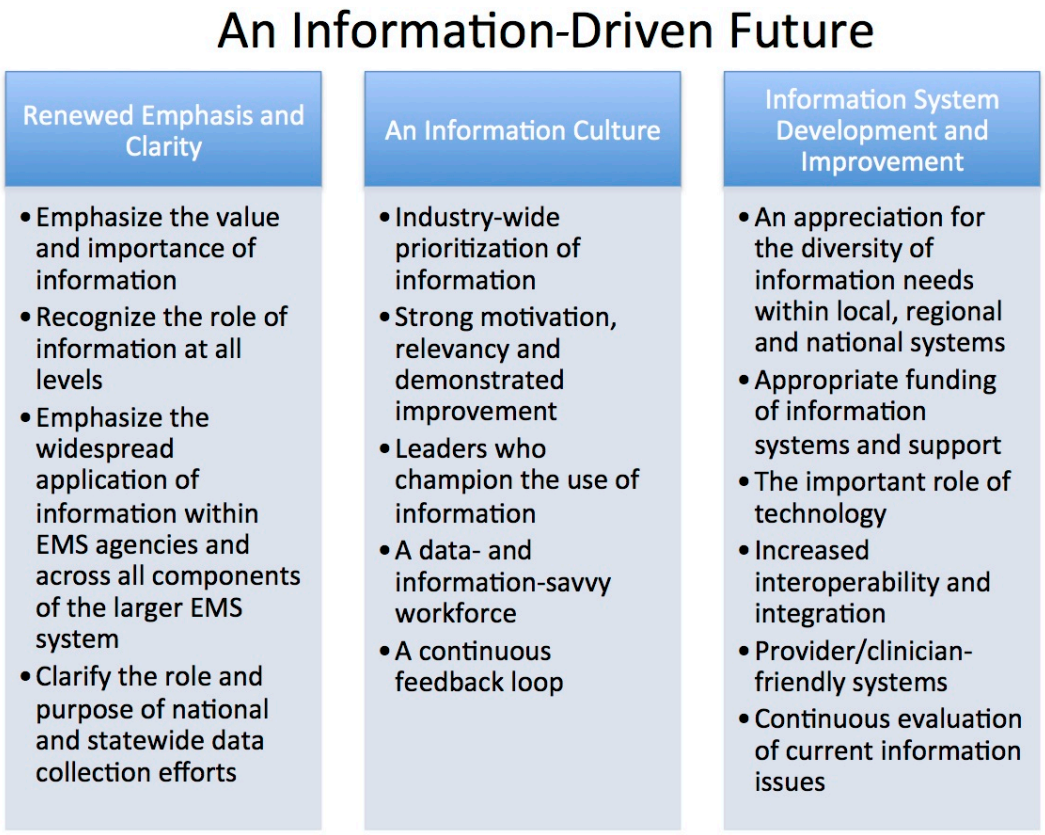
Envisioning an Information-Driven Future

In a rapidly changing world, timely and accurate information is essential to good decision-making. Emergency medical services (EMS) providers, organizations, payers, local officials, State governments, Federal agencies, and the general public need reliable, valid and accurate information about EMS systems in order to effectively care for patients and participate in public policy decision-making processes. Local EMS agency and system leaders need business information to effectively and efficiently deliver optimum patient care. Similarly, EMS field personnel need real-time data and feedback on their performance to best serve their patients.

EMS leaders, groups and governments have recognized this need for more than two decades, resulting in a variety of initiatives, projects and services that have led to noteworthy improvements in the way data are collected and used in EMS. Most U.S. States and territories participate in the collection of EMS records; and most submit all or part of that data to the National EMS Database, a component of the National EMS Information System (NEMSIS). However, improvements are needed to ensure that EMS truly becomes information-driven and translates its accomplishments into meaningful improvement. The path forward calls for:

- a renewed emphasis on and clarity about data and information use in EMS,
- the creation of an information culture, and
- ongoing information system development and improvement.



Project Process and Summit Meeting

This paper is the result of 10 months of work and study by a committee formed by the NHTSA Office of EMS (OEMS) to lend its expertise to the issue of data and information use in EMS. The committee was led by John Becknell, Ph.D., and consisted of two EMS software vendors, an EMS physician medical director, two EMS managers, an EMS attorney, two government officials and a project writer. The committee met several times by phone and two times in Washington, DC, to discuss the issues and plan a summit meeting about data and information use in EMS.

The summit meeting was held in July 2016. Nearly 50 invited guests representing a variety of national EMS organizations joined the committee in discussing the current state of data use in EMS and ways in which it might be improved. The goal of the summit was to envision a future in which EMS at all levels is inspired to collect and use data to drive meaningful change, and identify tactics for realizing such a future. The summit was prompted by several initiatives, including:

- The 2013 publication of a Federal Advisory on EMS data by the National EMS Advisory Council (NEMSAC) (see Appendix C);
- The 2013 publication of the Federal Interagency Committee on EMS (FICEMS) *Strategic Plan* that includes a goal of "Data-driven and evidence-based EMS systems to promote improved patient care quality";
- A 2014 request by the Joint National EMS Leadership Forum (JNEMSLF) to the Federal Interagency Committee on EMS (FICEMS) and NHTSA OEMS to create an *EMS Data Collection and Information Sharing Agenda for the Future*; and
- A 2014 recommendation by NEMSAC that FICEMS and NHTSA OEMS revise the 1996 *EMS Agenda for the Future.* That same year, FICEMS voted unanimously to revise the *EMS Agenda* with a focus on data-driven approaches to future improvements.

This document summarizes the findings of the committee as well as discussions at the summit meeting. It is not a consensus document. Rather, it is intended to provide feedback to the EMS community on the issues, to provide guidance to EMS leaders, and to provide valuable information for the revision of relevant sections of the 1996 *EMS Agenda for the Future*.

Where We've Been: The History and Background of Data in EMS

For many of its early years, EMS operated on best guesses, policies, procedures and operations derived primarily from a military model of trauma care that was adopted for a civilian population. Chief among the earliest concerns of emergency medical providers was responding to highway trauma, which was followed shortly thereafter by a recognized need for early intervention in cardiac arrest. EMS' "Golden Hour," its 8-minute response time standard, and the use of military anti-shock trousers all were based on limited clinical data and research.

As prehospital medicine evolved and became more sophisticated in the 1990s, many influential EMS leaders realized that reliable national EMS data was necessary for meaningful development and improvement in EMS. Specifically, they identified four areas in which data could make a difference: EMS education, outcomes, research, and reimbursement.

EMS Education: Thought leaders believed that data could assist EMS education in the development of improved curricula. "The absence of a national EMS database has been a significant impediment to the structuring of a coherent national EMS education system," Mears, Ornato, and Dawson wrote in *Prehospital Emergency Care.* "When the EMS National Standard Curricula were developed in the 1990s, only limited data were available on which to base decisions regarding training of EMS personnel. Despite a commitment to a data-driven curriculum development process, decisions were made based on the limited data available and, consequently, on expert opinion." [1]

Patient Outcomes: Similarly, EMS leaders argued that data could help providers improve patient outcomes by measuring the impact of EMS intervention on "something other than death."[2] They advocated for the use of data to measure clinical efficacy as well as EMS system performance. This idea was influenced by several influential publications. Among these was the 1991 American Heart Association report *Recommended Guidelines for Uniform Reporting of Data from Out-of-Hospital Cardiac Arrest: The Utstein Style*,[3] the first major Federal document to specifically address the impact of EMS on patient outcomes. The Institute of Medicine,

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[1] Mears, G., Ornato, J. P., & Dawson, D. (2002). Emergency medical services information systems and a future EMS national database. *Prehospital Emergency Care*; *6*(2),123–130.

[2] Mears, G. (2005). National EMS Database [PowerPoint presentation]. Retrieved from www.nemsis.org/referenceMaterials/presentations.html

Sayre, M. R., White, L. J., Brown, L. H., McHenry, S. D., & National EMS Research Agenda Writing Team. (2002). The National EMS Research Agenda. *Annals of Emergency Medicine*, *40*(6):636-43.

Sayre, M. R., & Gausche-Hill, M. (2002). Conducting randomized trials in the prehospital setting. *Prehospital Emergency Care*, *6*(2 Suppl), S38-47.

[3] Cummins, R. O., Chamberlain, D. A., Abramson, N., S., Allen, M., Baskett, P. J., Becker, L., … & Thies, W. H. (1991). *Recommended guidelines for uniform reporting of data from out-of-hospital cardiac arrest: The Utstein style*. Dallas: American Heart Association. Also published in *Annals of Emergency Medicine*, August, 1991.

addressing EMS for children, also stressed the need for reliable information as a basis for determining (1) the extent to which systems are providing appropriate, timely care or (2) what they should be doing to improve performance and patient outcome.[4]

EMS Research: Academics agreed with clinicians and government officials that data are essential to EMS improvement. They believed that EMS research would benefit from a national EMS database, which researchers could access to generate hypotheses, evaluate cost effectiveness of various EMS modalities, and identify problems and target issues. The 2001 *National EMS Research Agenda* made two recommendations about the important relationship among standardized data, research and clinical decision-making. Recommendation #6 read: "EMS professionals of all levels should hold themselves to higher standards of requiring evidence before implementing new procedures, devices, or drugs." And Recommendation #7, read, in part: "There should be standardized data collection methods at local, regional, State, and national levels."[5]

In their seminal article about the need for a national EMS database published in 2002, Mears, Ornato, and Dawson asserted, "Having access to a national EMS database could facilitate research efforts considerably, providing a large sample of standardized data from which to draw. Such a database would be invaluable in the generation of research hypotheses, evaluation of cost–effectiveness, and standardization of data used by researchers."[6]

Reimbursement: As the concept of pay-for-performance took shape in healthcare, EMS leaders believed that data also had the potential to play a significant role in EMS reimbursement decisions, including the national Medicare ambulance fee schedule that was being developed in the late 1990s. Mears, Ornato, and Dawson al linked data to reimbursement by stating, "More than ever before, EMS systems are being held accountable for their finances, quality of service, and patient care. All EMS information systems should incorporate billing and reimbursement data in a format that permits easy interaction with billing software, fulfills government regulations for Medicare reimbursement, and is compatible with other third-party payment requirements." [7]

EMS Agenda for the Future

Perhaps the most influential publication to advocate for the need to collect and use national EMS data to drive decision-making was the *EMS Agenda for the Future,* published in 1996. A national consensus document, it stated, "There is no central database, at a national level for example, that relates to the current practice of EMS. The data required to completely describe

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[4] Durch, J. S., & Lohr, K. N. (Eds.). (1993). *Emergency Medical Services for Children*. Washington, D.C.: National Academy Press.

[5] National Highway Traffic Safety Administration. (2001). *National EMS Research Agenda* (Unnumbered report). Washington, DC: Author. Available at http://www.nhtsa.gov/people/injury/ems/ems-agenda/EMSResearchAgenda.pdf

[6] Mears, Ornato, &Dawson, 2002.

[7] ibid.

an EMS event exist in separate disparate locations. These include EMS agencies, emergency departments, hospital medical records, other public safety agencies and vital statistics offices. In most cases, meaningful linkages between such sites are nonexistent. The lack of organized information systems that produce data which are valid, reliable and accurate is a significant barrier to coordinating EMS system evaluation including outcomes analyses."[8]

The *Agenda* made five specific recommendations for EMS information systems:

> (1) EMS must adopt a uniform set of data elements and definitions to facilitate multisystem evaluations and collaborative research;
>
> (2) EMS must develop mechanisms to generate and transmit data that are valid, reliable, and accurate;
>
> (3) EMS must develop and refine information systems that describe the entire EMS event so that patient outcomes and cost-effectiveness issues can be determined;
>
> (4) EMS should collaborate with other health care providers and community resources to develop integrated information systems; and
>
> (5) EMS information system users must provide feedback to those who generate data in the form of research results, quality improvement programs, and evaluations.

Five years later, the same argument was made by the Government Accountability Office in its October 2001 *Report on EMS* that advocated for consistent information to improve performance at a local level, set and monitor national level policy, and improve researchers' ability to assess EMS outcomes.[9] Despite growing awareness about the potential benefits of EMS data collection and use, in which "four Federal agencies have separately initiated attempts to collect EMS data or promote consistency in the data," the report stated, "…progress in developing such information has been slow." It continued: "In 2000, for example, fewer than one-fifth of States responding to a national survey indicated that they had the ability to collect information statewide in a format developed by the EMS community. State and local EMS officials said that a key reason for the lack of progress is that, faced with many competing demands on their time, EMS providers and local systems have few incentives to collect and report EMS information."[10] These challenges remain today.

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[8] National Highway Traffic Safety Administration. (1996). *EMS agenda for the future.* (Unnumbered report). Washington, DC: Author. Available at www.ems.gov/pdf/2010/EMSAgendaWeb_7-06-10.pdf

[9] General Accounting Office [now Government Accountability Office]. (2001, October) *Emergency Medical Services: Reported needs are wide-ranging, with a growing focus on lack of data*. (Report to Congress. Report No. GAO-02-28). Washington, DC: Author. Available at www.gpo.gov/fdsys/pkg/GAOREPORTS-GAO-02-28/pdf/GAOREPORTS-GAO-02-28.pdf

[10] Ibid.

A Focus on Data Collection: The Evolution of the National EMS Information System

In fact, by 2000 NHTSA had already launched a national effort focused on data collection, called the National EMS Information System (NEMSIS).[11] It had begun in earnest in 1999 with a feasibility study, followed in 2000 by a national focus group. Both efforts were led by the National Association of State EMS Directors (now called the National Association of State EMS Officials, or NASEMSO). In 2001, NHTSA and HRSA's Maternal and Child Health Bureau's EMS for Children Program funded the State directors to develop a national EMS information system, which was launched in 2002.

The State directors, in conjunction with NHTSA OEMS, created the original NEMSIS dataset based upon the Utstein Criteria and NHTSA's Uniform Prehospital Data Set, a national consensus document published in 1993 that defined 81 elements important to an EMS information system. Of the 81 elements, 49 were considered "essential" and 32 "desirable." These dataset elements were envisioned to allow EMS systems to benchmark themselves with others in areas such as service, patient care, personnel performance, patient outcome. It also envisioned the ability to link EMS data with other datasets in the healthcare sector, such as local, State and national trauma registries, cardiac arrest registries, and NHTSA's Crash Outcomes Data Evaluation System (CODES).[12]

At the time of the NEMSIS launch in 2002, proponents had high hopes that national, standardized EMS data would make a real difference in EMS performance. They wrote, "Once implemented, a national EMS database will serve many purposes:

- help public officials and the general public better understand EMS;
- drive policy and make funding decisions;
- identify national trends in patient care and policy;
- facilitate national benchmarking while recognizing individual State and local variations;
- assist in identifying and decreasing errors in clinical management;
- provide data to assist with business structure and management;
- promote research, including hypotheses generation;
- help establish national EMS outcome measures;
- clarify how EMS fits into the total public health care system;
- drive implementation and facilitate monitoring of the *EMS Education Agenda for the Future*;
- identify unmet needs and priorities from Federal partners; and
- determine the effectiveness of EMS systems and EMS patient care."[13]

[11] See Appendix B for a more detailed timeline of the evolution of NEMSIS.

[12] A description of the Crash Outcome Data Evaluation System (CODES) can be found at www.nhtsa.gov/Data/State+Data+Programs.

[13] Mears, Ornato, & Dawson, 2002.

NEMSIS Becomes a Reality

Today, NEMSIS is a NHTSA-led national effort to standardize the data collected by EMS agencies and use that information to improve care. NEMSIS has three primary goals and objectives.[14]

- An **electronic EMS documentation system** in every local EMS system, which can be used to collect and use data based on the current NHTSA Version 3 dataset standard.

- A **State EMS information system** in every State and territory, which can receive and use a portion of the local EMS data via the NEMSIS/HL7 XML standard,[15] and

- A **national EMS database** with reporting capabilities, allowing Federal, State and local EMS stakeholders access to performance and benchmarking metrics.

Under the guidance of a NEMSIS Technical Assistance Center (NEMSIS TAC), the NEMSIS program had reached several milestones as early as 2006, including:

- Several versions of an event-based national EMS dataset. Event-based data intends to capture the entire EMS event, from activation of the EMS system through the release of the patient from EMS care;
- A physical database scheme mapped to the NEMSIS dataset with XML linkage;
- A definition of a national EMS system dataset (a much smaller subset of the full dataset); and
- A business plan for the implementation of a national EMS information system. [16]

Currently, the national EMS database collects over 30 million ground EMS activations each year, which NEMSIS calculates to be about 81 percent of calls made each year. To date, 49 States and territories submit EMS activations to the national NEMSIS database Version 2. (States and territories not submitting Version 2 data include MA, OH, TX, and DE. All other States and territories submit some percentage of their EMS activations to the national database.)

Since 2014, NHTSA has led a transition to a newer, more expansive version of its NEMSIS dataset, and it has announced that it expects all States to upgrade to Version 3 by the end of 2016. Version 3 expands the national data elements from 78 primarily clinical measures to more than 200 measures that add a significant measure of operational data to NEMSIS. According to NHTSA, NEMSIS Version 3 is significantly improved over previous versions in that is also "moves information in near real-time, is compliant with international health data

[14] Retrieved from www.nemsis.org/theProject/whatIsNEMSIS/goalsAndObjectives.html

[15] Health Level Seven International (HL7) is a ANSI-accredited standards developing organization dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services.

[16] Dawson, D. E. (2006). National Emergency Medical Services Information System (NEMSIS). *Prehospital Emergency Care*, *10*(3), 314–316.

standards (HL7), and allows for more precise understanding of what works and what doesn't through outcomes research, for example, by collecting vital sign information at State and national levels."[17]

The Federal government continues to fund NEMSIS and the NEMSIS TAC, which is charged with providing technical assistance to U.S. States and territories that participate in the project, as well as electronic patient care report (ePCR) vendors that are essential to the data-collection process. Currently, the NEMSIS TAC is operated through a contract with University of Utah; however, NHTSA has initiated a process to bring the National EMS Database in house to NHTSA servers to allow easier access and ensure continuity of operations. A NEMSIS Technical Assistance Center will continue to support EMS data customers in the future.

[17] Interview with NHTSA OEMS staff, March 2016.

Where We Are Today

Since the inception of modern EMS, EMS data collection and use has developed in two distinct ways. The first is a national EMS information system envisioned and created by State and Federal officials (described above). It was and continues to be a top-down-driven system in which the Federal government has tasked U.S. States and territories with collecting statewide, standardized EMS data and submitting it (or a portion of it) to a national EMS data repository (National EMS Database). States, in turn, require local EMS organizations to submit their EMS data to State databases. The effectiveness, validity, reliability and use of State and national EMS databases varies from place to place. This national EMS information system was created primarily in service of researchers, government and public policy-makers and without full buy-in from local agencies and field providers.

The second way that EMS data has been collected and used is at a local level. In local EMS organizations, the approach to data collection and use is often simple and practical. For example, EMS managers may look at chute times to determine whether they have enough resources in their field operations (chute time is typically extended when there are fewer people to respond to calls). Useful data within an EMS organization may be found in hard copy documentation of equipment inventory and vehicle maintenance, for example; and/or it may be captured and accessed electronically in dispatch systems, scheduling software and patient care reports. More sophisticated EMS agencies use internal, local, and/or regional EMS data and information to improve organizational, financial and clinical performance.

The disconnect between standardized, national EMS data collection and use and more organic, local EMS data collection and use has resulted in misunderstandings and malcontent with the current state of data collection and use in EMS. Challenges and opportunities exist at the national, State and local levels, as well as with issues surrounding integration of EMS and its data with healthcare as a whole.

The following material summarizes some of the existing challenges that were enumerated by the project committee and participants in the Beyond Data summit. This list does not reflect a group consensus about any of these specific challenges.

Challenges and Opportunities at the National Level

- National EMS data initiatives have focused on quantitative event and clinical data aimed primarily at supporting EMS policy decisions and related research. There is an opportunity to make data in the National EMS Database more relevant to local and agency-level decision-making.

- The National EMS Information System is poorly understood. NHTSA OMS has an opportunity to more effectively explain and market NEMSIS and its benefits. There are

problems of both definition and perception. (See Appendix A for a Glossary of Terms and Definitions that defines many of the basic words and concepts used in EMS data collection and management.)

- While NEMSIS and the State EMS offices have collected a lot of EMS data, there has been limited widespread analysis of that data and information derived from it.

- Technical assistance for national data initiatives has focused primarily on defining datasets, collecting data, working with States to comply with data standards, and supporting academic research. The primary customers of the NEMSIS TAC are the entities responsible for data collection (State Offices of EMS and ePCR vendors.) Secondary customers are those who use the data, primarily researchers. There is an opportunity for national EMS data to be made more readily accessible outside of research circles and to make it available more quickly or, preferably, in real time. There is also an opportunity to better prepare local EMS leaders to use data.

- A challenge exists in integrating EMS data collected under previous versions of NEMSIS with the data being collected in Version 3.

- There is a disconnect between the bulk of standardized data collected at the national and State levels and the top issues, challenges, needs and opportunities facing local and regional EMS and organizations and systems.

- States have different data systems and there is a lack of standardization among those systems. This results in increased expense and time in the development and support of software needed by local agencies to collect the data.

- There is a perception and probable reality that the quality of data varies widely.

Challenges and Opportunities at the State Level

- State data initiatives have developed alongside and in support of national initiatives. As a result, State data collection programs have largely focused on agency reporting compliance, with limited reporting of information and statistics derived from statewide data.

- Each State is unique in how it collects data. The reliability, validity and effectiveness of data collection and use varies State-to-State.

- Some State Offices of EMS that have invested heavily in mandating data collection are concerned that it is not worth the return on investment. States have the opportunity to share best practices and better work together to find value in the data they collect.[18]

- Many State Offices of EMS have limited resources and are reluctant to invest more in data collection and analysis without realizing a clear return or benefit. In many States the optimal return or benefit is not communicated or perhaps known to leaders.

- Some States have been ineffective in adequately communicating with local agencies/systems about why data collection is important. The EMS community perceives State data collection as largely about regulatory compliance. Local EMS agencies and providers want evidence that State and national data collection is producing information that can improve what matters most to local agencies/systems and to those charged with collecting data. States have an opportunity to clarify why they are collecting EMS data and better share their perspective and the results of their data collection and analysis efforts with local EMS agencies.

- When EMS began its national data collection efforts, prior to the development of ePCRs, States were necessary to the NEMSIS data collection process. With the advent of new technologies, this may no longer be the case. The role of States in ensuring compliance with standardized data collection is important; however, their role in data collection, data management, data administration, research facilitation and research itself may no longer be essential, effective or efficient. The opportunity for EMS is to evaluate how best to collect, manage and use data.

- States may be limiting competition in the ePCR market by modifying national data standards such that getting into the market and meeting many different State standards is difficult if not impossible. A single, more comprehensive national standard dataset would allow for a fairer playing field and allow States to collect extra data important to them and have control of data without the burden and costs associated with collection, management and storage.

- EMS stakeholders have an opportunity to address widespread skepticism and pessimism in the EMS community about the value of State and national data collection efforts and about large-scale data collection and management efforts, in general.

[18] Erich, J. (2016). Harnessing data for real improvements. *EMS World*, *45*(5). Retrieved from www.emsworld.com/article/12205671/harnessing-data-for-real-improvements
Additional reading material on EMS data use at all levels is listed in Appendix D.

Challenges and Opportunities at the Local/Provider Level

- Many people in EMS do not embrace a data-driven culture. As a result, the value of standardized EMS data collection is not well understood or appreciated at a local level.

- The collection and use of EMS data to guide improvement at the local level is not uncommon, but the amount and sophistication of data/information collection and use varies widely.

- Local agencies and systems are not using national EMS data or even the expanded State data. EMS as a whole deeply underuses national and State EMS data for research and decision-making.

- Important issues, challenges, needs and opportunities at the local level are often addressed and decisions made without information/data.

- The EMS community often perceives the term "data collection" to be a complex system of definitions, technology and quantitative analysis connected to complicated term-heavy theories of quality improvement. The EMS community has an opportunity to change this perception.

- Many people in the EMS community perceive that national data initiatives are attempting to do too much, are focused primarily on large-scale research, have not lived up to the investment, are collecting data that is low quality, and are not meaningful for local systems.

- The EMS community perceives there is little connection between the information needed to address local issues, challenges, needs and opportunities and data collected at the State and national levels.

- Local EMS agencies/systems look for information that connects with their most pressing and top concerns, which are often about organizational survival and basic operational needs. Local EMS agency/system top concerns center around operational performance and efficiency, finances, workforce, resource deployment, community recognition, leadership, and healthcare integration. Local leaders report being concerned about filling job vacancies with quality staff, staffing units, response time, turnaround time, bed wait times at hospitals, reconciliation of PCRs to the billing system, financing reasonable operations, containing costs, survival, and developing ways to garner local support. These issues often trump issues around clinical care, events and clinical improvement. Even though clinical care, events and clinical improvement are important, they may not be most urgent on a daily basis.

- Local data collection and use of information derived from analyses of collected data are often inhibited by limitations in local leaders' knowledge and preparation, time and other resources.

- Local data use is often inhibited by collection systems not being medic-friendly. Software vendors are seeking to mitigate this issue, but are hindered by national and State demands that EPCRs must have hundreds of data points to comply with national and State standards, which often vary State to State.

- There is an absence of meaningful performance measures connected to local operational issues, challenges, needs and opportunities.

- Local agency/system leaders may be reluctant to share data and information about operations, finances, workforce and community support with other agencies/systems even though they may benefit from cross-agency comparison.

- Most of the nation's EMS agencies are small, rural and have limited resources to devote to information/data collection and analysis.

- The collection of reliable EMS data requires EMS providers to spend time and energy understanding and collecting appropriate data. They are not motivated to do this. Furthermore, in order to ensure accuracy, effective data collection takes regular and ongoing training to ensure widespread understanding of data definitions. This problem of having the time, motivation and training necessary for accurate data collection is likely to worsen under NEMSIS Version 3.X, which has more data points than before.

Challenges and Opportunities With Healthcare Integration

- Local data are often in silos and not integrated with hospitals' or patients' electronic health records.

- In obtaining meaningful information about clinical practice, EMS faces barriers with regard to collection of outcome data from hospitals. Poor integration between the EMS ePCR and the patients' electronic health records inhibits analysis of EMS practice, care and impact. Slow improvement of this situation is being reported.

- Challenges exist with regard to who owns the EMS data that are collected and how they may be disseminated and used.

Assumptions About Data Collection and Use

In planning and envisioning a future, some assumptions must be made. The project committee offers the following:

- Historically, EMS developed locally and organically, and as a result, the power to make change resides at the local level.

- Collecting and analyzing data has been demonstrated to be a best practice in driving meaningful improvement. Improvement thrives in an information-rich environment.

- There are numerous data points that can be collected and analyzed about an event, organization, system and industry. There are limited resources available for collection and analysis. The challenge is prioritizing the right data to collect and analyze.

- There are many issues, challenges, needs, and opportunities facing EMS organizations and systems across the U.S. that could benefit from the collection and analysis of the right data.

- The need for and interest in information is most acute when centered around top issues, challenges, needs and opportunities.

- EMS leaders' and providers' interest in data collection is related to their perceptions about whether the effort will result in meaningful information and improvement to the things they value.

- Data collectors who witness or experience meaningful improvement from their efforts are likely to be better, more reliable data collectors.

- When agencies or systems are struggling to fulfill their basic mission and survive, interest in and patience with collecting data that does not relate to their immediate challenges declines.

- The future of State and national data collection/management is in jeopardy because of lack of funding at the local, State and national levels and because it is disconnected from vital issues, such as rising costs and declining reimbursement.

- Many EMS leaders are interested in improving their agencies and systems; however, many lack basic understanding of how to derive information from data.

- Leaders are essential to the adoption of a culture of information-driven decision-making. Their buy-in and the buy-in of providers who actually generate the data are essential to success.

- The national effort to collect EMS data may not serve all needs for everyone. It is only one piece in a much more complex effort to use information to better understand the impact of EMS on the broader healthcare system and drive decision-making.

Envisioning an Information-Driven Future

In a rapidly changing world, timely and accurate information is essential to good decision-making. EMS providers, organizations, local officials, State governments, Federal agencies, and the general public need reliable, valid and accurate information about EMS systems in order to effectively care for patients and participate in public policy decision-making processes. Local EMS agency and system leaders need business information to effectively and efficiently deliver optimum patient care. Similarly, EMS field personnel need real-time data and feedback on their performance to best serve their patients.

EMS leaders, groups and governments have recognized this need for more than two decades, resulting in a variety of initiatives, projects and services that have led to noteworthy improvement in the way data are collected and used in EMS. Most U.S. States and territories participate to some degree in the collection of EMS data; and most submit all or part of that data to the National EMS Information System (NEMSIS) database. However, more progress is needed to ensure that EMS truly becomes information-driven and translates data and information into meaningful improvement. The path forward calls for:

- a renewed emphasis on and clarity about data and information use in EMS,
- the creation of an information culture, and
- ongoing information system development and improvement.

Renewed Emphasis and Clarity

Becoming truly information-driven demands a renewed emphasis by all EMS stakeholders on the necessity and value of information, as well as greater clarity about meaningful use of data at all levels. Specifically, EMS should embrace the following concepts and seek ways to put them into practice at all levels.

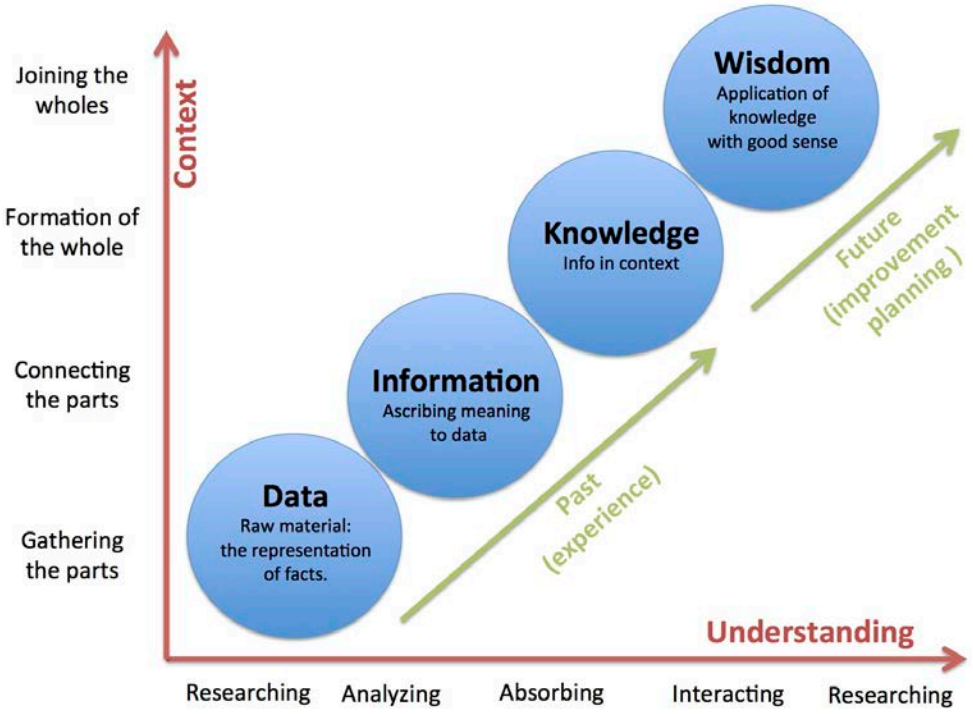
Emphasize the value and importance of information

In the 1996 *EMS Agenda for the Future,* Daniel Spaite, MD wrote, "Finding desperately needed answers to many important questions in EMS is hopeless without the development of new ways to collect, link, and analyze valid, meaningful information. This is the very foundation of the future of EMS!"[19] This observation remains true today. While there has been significant investment and work on data collection of the past two decades, EMS must continue to emphasize and demonstrate that the best decision-making, planning, problem-solving and improvement occurs in an information-rich environment. At all levels of EMS from the provider to national leadership, every aspect of EMS should be evaluated from the perspective of information.

[19] NHTSA, 1996, p. 55.

Recognize the role of information at all levels of sophistication

As EMS has developed ways to collect, link and analyze information, often it has done so in a complex manner that relies on time-consuming data entry, sophisticated data analysis, and complicated quality improvement processes. EMS should emphasize that information-driven improvement need not be complex. It may be simply about seeking to better understand a challenge, process, practice, need or opportunity using basic, simple information. Gathering and using data need not be complicated, onerous, out-of-reach or something that only happens at State and national levels. The following diagram[20] presents a picture of what data are and how it relates to information, knowledge, wisdom and improvement.



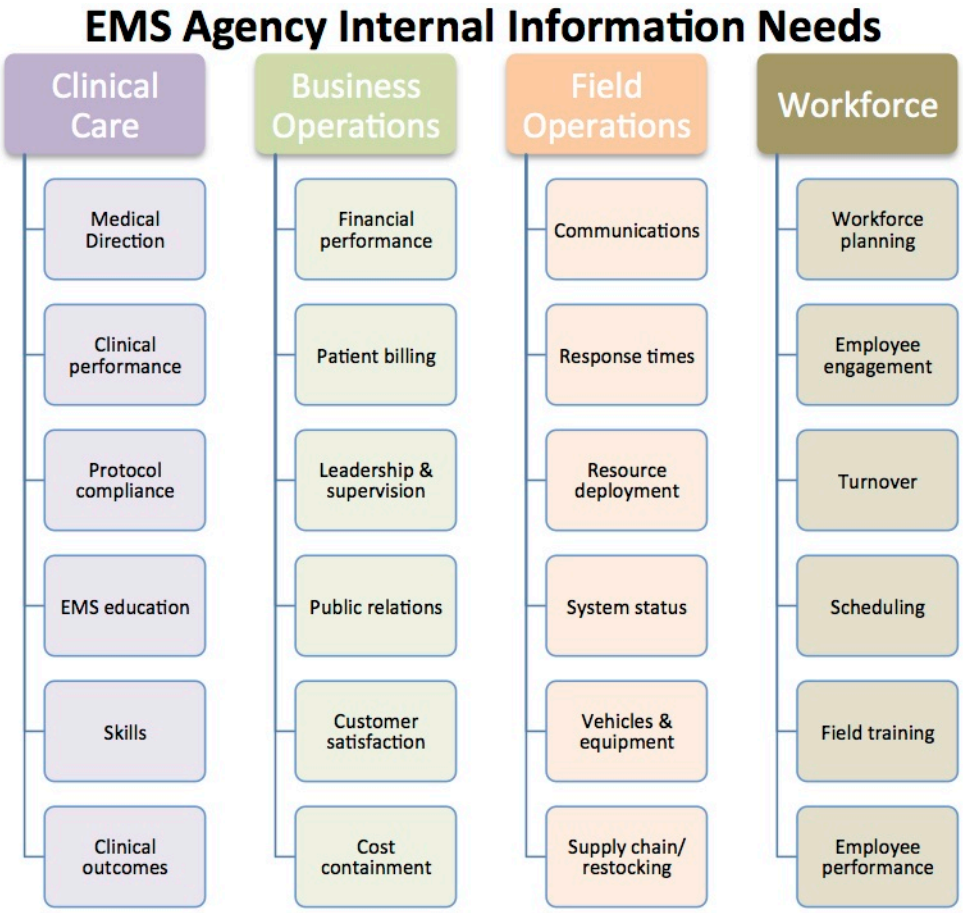
Highlight widespread application of information within EMS agencies and across all components of healthcare and public safety

While much of national and State data collection efforts to date have been heavily focused on clinical event data, information use in EMS has much more wide-reaching applications. EMS organizations should be encouraged to use data and information in both clinical and non-clinical settings to make decisions not only about patient care but also about operations, budgets and spending, scheduling, purchasing and maintaining vehicles, strategic planning, etc.

[20] Diagram adapted from: Ackoff, R.L. (1989). From Data to Wisdom. *Journal of Applied Systems Analysis*, 16, 3-9, and Esterbrook, S. (2012). What is Climate Informatics? Retrieved from www.easterbrook.ca/steve/2012/09/what-is-climate-informatics/.

Medical directors, likewise, should use the most current EMS clinical information to drive decision-making regarding protocols, scope of practice, standard operating procedures, etc.

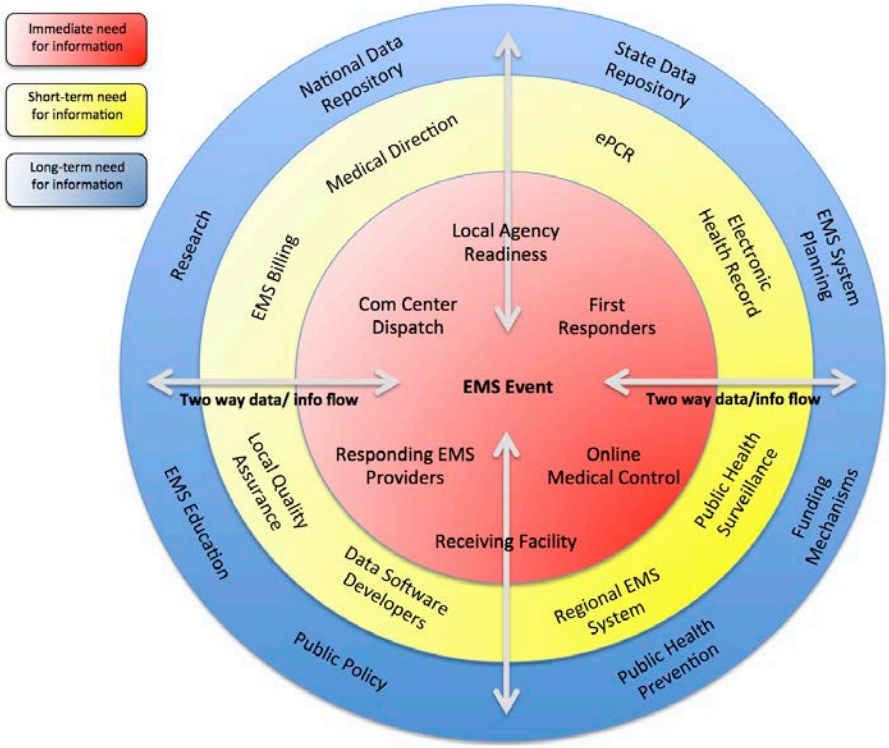
The illustration below suggests some of the many ways that data and information may be used to make decisions in an EMS organization in the areas of field operation, business operations, workforce planning and clinical care.



EMS exists simultaneously as part of public safety and healthcare, and as a result, an interdisciplinary approach to information is needed. Data and information should flow in all directions within all elements of public safety and healthcare. EMS should encourage collaboration within and among EMS, public safety and healthcare to ensure that all aspects are represented in the data and information equation. As a healthcare provider (not simply a supplier), EMS should be fully integrated into EHR (electronic health record) systems.

Without being comprehensive, the illustration below demonstrates the complex nature of data and information gathering and sharing within EMS. The flow of data and information is bi-directional. The timeliness in which data and information is needed varies.

Complexity and Flow of EMS Data and Information



<u>Clarify the role and purpose of national and statewide data collection efforts</u>
NEMSIS represents only one element in what must be a much more comprehensive effort to create an information-driven future for EMS. No single EMS information system can be everything to everyone; therefore, EMS should clarify the specific purpose of NEMSIS and State EMS information systems, defining what they aim to accomplish, whom they serve, and what industry stakeholders can expect from them.

The best role for the States to play in a national EMS information system is unclear at this time. Currently, States serve as data collection points for standard event data, often mandating data reporting by local agencies to State EMS data systems. In some States, data collection has been used as a "stick" more than as a "carrot," and failure to comply with data-reporting requirements has resulted in punishment. Many EMS providers would prefer that EMS data collection not be used in a punitive or regulatory way. Rather, they seek to see a return on the investment that they are making in data collection through the generation of meaningful and relevant information that can help them optimize patient care. It is incumbent upon State EMS officials to lead efforts to collect and use data in a meaningful way. States should coordinate

with one another and share best practices to facilitate effective and affordable data collection and meaningful use at the State level.

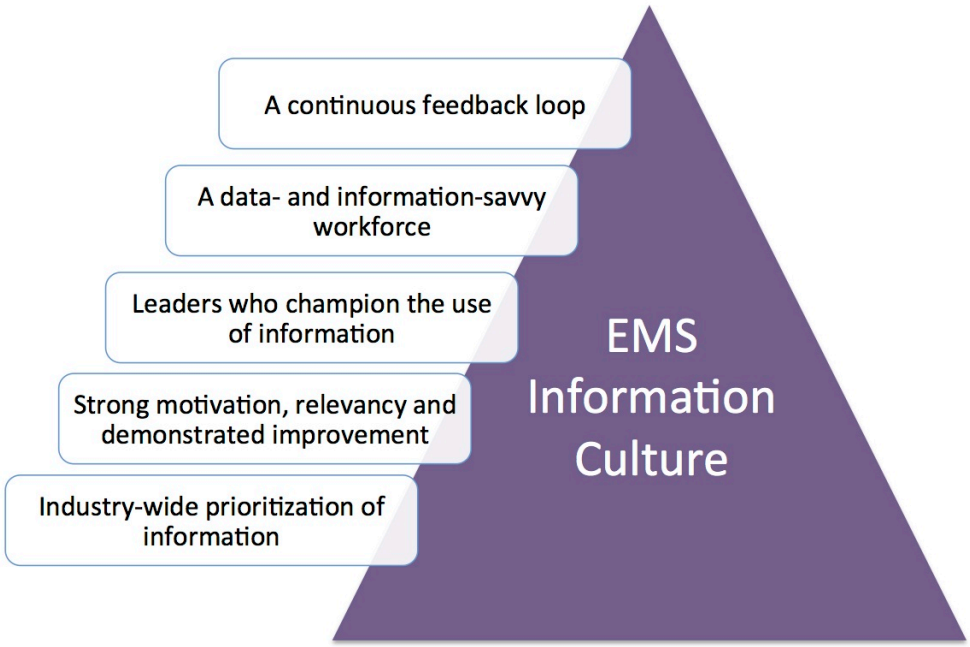
An Information Culture

EMS should embrace a culture that values data and information as essential to the ongoing maturation of EMS in the 21st century. Such a culture stands in stark contrast to the reactive culture that operationally drives EMS. Because the dominant operating paradigm of EMS is one of reactivity and rapid response (hear the call for help and run towards the emergency), EMS typically has not prioritized the collection and analysis of data and information to guide problem-solving, planning, decision-making and improvement. Its default culture is one of gut-reaction, best-guess and imitation of others.

Importance of Information Culture

	Improvement Opportunities	Decision Making	Data Collection
Absence of Information Culture	• Opportunities often hidden • Improvement is disconnected and random • Focused on immediate	• Reactionary • Focused only on problem solving • Prescriptive • Absence of understanding and cause analysis	• Not valued • Collection systems not developed or improved • Viewed as burdensome
Presence of Information Culture	• Opportunities continuously sought • Improvement connected and meaningful • Future focused	• Proactive • Focused on improvement • Guided by data and learning • Results in deeper system and process understanding	• Valued • Viewed as opportunity • Collection systems developed and improved

EMS must consciously resist its reactive culture and create a proactive culture of information based on the following priorities.

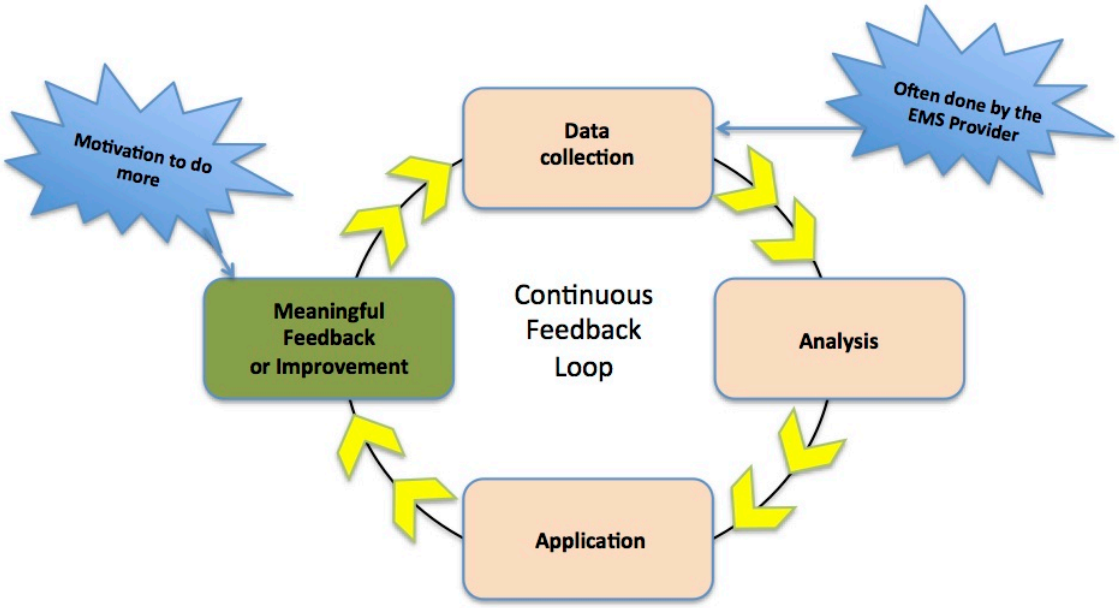


Industry-wide prioritization of information

EMS should prioritize improvement and meaningful change driven by information and integrate the notion of an information-driven culture into its beliefs, attitudes, thinking, values, education and leadership in such a way that its behaviors, actions and practices are truly grounded in best processes and practices. This means pursuing information-driven decision-making, problem-solving, planning and improvement in every facet of the EMS system, including resource deployment, budgeting, workforce management, vehicle maintenance and billing, to clinical protocols, patient outcomes, customer satisfaction and public policy. EMS should relentlessly pursue knowledge about its assumptions, protocols, practices and results.

Strong motivation, relevancy and demonstrated improvement

EMS leaders and providers everywhere should be eager to draw on data and information to make decisions that improve their systems, agencies and services. This eagerness should result from a common understanding that data and information are simply facts and numerical information that can be used in calculating, reasoning, planning and decision-making and can be used to address the most pressing and relevant challenges. Data and information derived from it also must be meaningful to those who are tasked with collecting it. This means that data collection must provide feedback and be connected to the issues and challenges impacting those collecting data. Motivation will grow when improvement and problem-solving is witnessed or experienced.



Leaders who champion the use of information

Leaders at all levels are key to strengthening the use of information. This means that leaders must understand, believe in, value and champion the use of information to guide decision-making, problem-solving and planning. EMS leaders at all levels should have easy access to education and training on how to collect and use data to operate their organizations effectively and efficiently. There should be ample educational opportunities, written resources, coaches and mentors and data-collection and analysis tools (surveys, software, matrixes) in support of data-driven decision-making. Opportunities should exist to teach EMS managers and leaders to use information to make decisions through ongoing in-house education, more formal continuing education, and at local, State and national conferences. EMS organizations also should encourage and support their leaders in furthering their education about information systems in more formal institutional settings.

A data- and information-savvy workforce

An appreciation for an information-driven culture must start in the very earliest stages of one's EMS career with the education and training programs that shape future EMS providers and leaders. The importance and value of accurate data collection should be included in core EMS educational standards and taught in EMS education programs. EMS educators should teach students how to use data to inform decision-making both in the field and in the EMS business office. They should share clear examples of improvement that results from gathering information, rather than reacting or imitating. These examples should connect to practical, operational and/or patient care practices. Providers should be shown how to apply simple information processes to decision-making about everyday challenges and problems. EMS should introduce this concept in a format that is easy to grasp and allows for early success (meaningful improvement). Education in the use of data and information to drive decision-making should continue throughout one's EMS career.

A continuous feedback loop

The payoff for collecting data is the information, knowledge and wisdom that can be used for decision-making, problem-solving, planning and improvement. EMS has a unique situation in which its frontline providers are often data collectors about events and care rendered to patients. Continuous and valuable feedback is essential to the sustainability of an information culture. In the absence of feedback, data collection becomes meaningless, and data collectors become weary of the process and doubt its value.

Information System Development and Improvement

Information systems are made up of processes and tools designed to gather and analyze data and information. There is no single information system that can do everything. Therefore, systems are continually developed, evaluated and improved. EMS should apply the following principles to improve existing information systems and develop new ones.

An appreciation for the diversity of information needs within local, regional and national systems

The ways in which information can be gathered and analyzed are many. Information systems can be simple or complex. Systems typically include the gathering of data, the organization of data into information, analysis of information, and feedback. EMS, public safety and healthcare have a wide variety of information systems that exist at local, regional, State and national levels. NEMSIS serves a particular purpose but can not do everything. A variety of information systems are needed and NEMSIS represents only one element in what must be a much more comprehensive effort to create an information-driven future for EMS. That effort must encompass not only Federal projects to collect EMS data on a national scale, it also must include regional and local strategies to make the collection of EMS data and the use of information paramount in EMS decision-making at all levels, from the field provider through EMS agency management to medical directors to public-policy makers.

EMS information systems are needed to provide information about all aspects of EMS, including the following.

- prevention
- call taking
- dispatch
- communications
- response times
- resource need
- resource deployment
- workforce development
- workforce scheduling
- equipment
- vehicles
- supply chain
- facilities
- clinical care
- medical oversight
- protocol development
- patient care
- patient outcomes
- protocol and practice effectiveness
- medical direction
- public relations
- provider performance
- supervision and leadership
- EMS education
- finances
- billing
- overall system performance
- public policy development

Even as EMS exists simultaneously as part of public safety and health care, it also has and will continue to be driven by local needs and goals. EMS has a long history of being locally focused, and as such, its information systems must be responsive to local needs. The collection and use of EMS data must be flexible and scalable to fit the varied capabilities of diverse EMS agencies. Likewise, information derived from the collection of EMS data must be meaningful to the local agencies and individuals that collect it.

In addition to the question of what data to collect, there is the issue of what information can be generated to produce meaningful change, and whether that information can be generated in a timely manner. Different user groups have different needs, and EMS information systems must recognize those differences. For example, the collection of local data should be guided by local needs and challenges and what matters to the local agency/system. Data and information should be used to design and improve systems. Priority should be given to the collection of data points that matter most. Common challenges such as scheduling, resource deployment, workforce planning, financial operations and service and clinical performance should be well understood and addressed using data and information.

Unlike researchers and policy-makers who may want to look at EMS data longitudinally, EMS field providers have the need for EMS and health care patient data to generate useful information in real-time and help them provide optimal care. Supervisors also need real-time data and should have data-driven operational and workforce dashboards that keep them continually and appropriately informed about field performance. Decision-support software is another way in which EMS could benefit from real-time EMS information. And, ultimately, EMS is going to have to ensure that its EMS event data integrates with electronic health records.

The chart below suggests the various speeds with which different groups need EMS data, information and feedback.

Feedback over Time	Immediate	Minutes	Hours	Days	Months	Years
Call Center / Dispatch	✓	✓	✓			
Field Providers	✓	✓	✓	✓		
Local Agency	✓	✓	✓	✓	✓	
EMS System	✓	✓	✓	✓	✓	✓
Medical Director			✓	✓	✓	✓
Healthcare System				✓	✓	✓
State EMS Office					✓	✓
National EMS Database (NEMSIS)					✓	✓
Researcher/Public Policy					✓	✓

Appropriate funding of information systems and support

As EMS leaders consider the creation of an information-driven future, they must recognize that there are significant costs associated with figuring how best to develop and maintain EMS information systems that promote meaningful change. These costs include time, energy, and resources at local, State and national levels. Therefore, it is essential that across all systems, the collection and use of EMS data be as efficient and affordable as possible without compromising quality. At the same time, EMS cannot avoid paying for information systems and support at the local, regional, State and Federal levels. Such funding should be built into budgets at all levels. National EMS leaders should continue to fund projects that collect and use EMS data for meaningful performance improvement. Funds also should be allocated for projects that develop meaningful performance indicators (e.g., Compass Project).

The important role of technology

The effectiveness of information systems depends on many things, including design, clarity of purpose, financial resources, quality of data gathered, appropriate analysis, and the system's ability to share and compare data and information with other systems. In the 21st century, technology also is an integral part of the way in which we gather and share information. EMS must look for best practices in information technology. It should draw upon a variety of technological resources to serve its rapidly changing and complex information needs. At the same time, EMS must work with experts in software development, public safety and healthcare to develop technology that can be applied across the disciplines, as the interface among EMS and electronic health records (EHR) and health information exchange (HIE) is critical to the future. EMS should create opportunities and forums for software developers and vendors to better understand industry needs, share ideas, and continue to support EMS information use. EMS also should ensure that the responsibility for learning how to use data and information and transform it into meaningful change does not rest on the shoulders of software developers and vendors, but instead, is an industry-wide responsibility shared by agencies, association and government.

Increased interoperability and integration

Data collected about EMS events must be effectively integrated with event and patient data collected through public safety and healthcare information systems. Particular emphasis should be given to the role of EMS in the continuum of patient care to allow for accurate assessment of the effectiveness of EMS intervention and its impact on patient outcomes.

Toward this end, EMS vendors should work together and with vendors of various public safety and healthcare information software to achieve seamless integration from 911 dispatch through the patient's discharge from the health care system. Interoperability of software and hardware, where applicable, must be paramount. One way to facilitate this goal is for EMS and healthcare to adopt unique patient identifiers to track patients throughout healthcare system. Effectively sharing data across organizations and disciplines will require agreed upon standards and adherence to those standards. There may be a need for a national EMS governance structure to guide clinical and administrative information sharing.

EMS must work with healthcare leaders at all levels to address perceived barriers to sharing information due to the Health Insurance Portability and Accountability Act (HIPAA). When there is a shared value for information perceived barriers can be overcome.

Provider/clinician friendly systems

Under the current top-down-driven, NEMSIS-led system of EMS data collection, a disconnect exists between the national vision for EMS information use and the daily reality of most EMS providers. Part of the reason for this disconnect is that the provider's experience and provider input has not always been voiced or valued. This problem is not unique to the EMS data discussion, or to EMS.

Much of healthcare has focused on the Triple Aim, an idea promulgated by the Institute for Healthcare Improvement that suggests that healthcare should a) improve the patient experience of care, b) improve the health of populations, and c) reduce the per capita cost of healthcare. This three-pronged approach leaves out the clinician, and as a result, there is a movement afoot to add a fourth component to the conversation.[21] In terms of EMS data, the fourth or missing aim would be the EMS provider's experience of data collection, use and data collected about the providers' experience.

[21] Bodenheimer T, Sinsky C. (2014). From triple to quadruple aim: care of the patient requires care of the provider. *Annals of Family Medicine*. 12(6), 573-576.

To improve the meaningfulness of EMS data collection, frontline EMS workers must see how data are used to improve their work environment, the health of their organizations, and the services they provide. Likewise, on a daily basis, supervisors should be able to use data and information to guide and prioritize what matters most in overseeing operations. As local appreciation for data use grows, the quality for data collected for State and national data management will improve.

Entering data into EMS information systems should be intuitive and user-friendly to minimize the time that it takes EMS personnel to effectively accomplish the task. Best practices for data input should be considered, and vendors should pursue maximum usability in designing data entry software to allow for rapid completion of data-entry tasks. Natural language processes and voice recognition technology should be pursued as alternatives to traditional data entry methods. Data entry training should be provided as much as necessary to ensure accuracy of data collected.

Continuous evaluation of current information systems

As with EMS in general, there must be an ongoing process for evaluating EMS information systems to ensure that they meet industry needs in a rapidly changing public safety and healthcare environment. This evaluation process must begin with NEMSIS. EMS should study whether, in its present incarnation, NEMSIS is collecting the right data the right way. Likewise, is the NEMSIS TAC serving the industry as best as it can, or should its mandate be revised? EMS should look for "low hanging fruit" in terms of meaningful information that can be gleaned from existing NEMSIS data and shared with the EMS industry. The same kind of questions should be raised at a State level: Are States collecting the right information the right way? Do they have the right kind of support systems in place to use that data to create meaningful information that can be shared? How should NEMSIS and State EMS data collection systems be changed to better serve industry needs and help advance EMS integration with information systems in healthcare? A modular approach to data collection may be useful to meet varied needs.

HIPAA notwithstanding, it is also unclear how data and information can and should be shared once they are collected. EMS leaders disagree about whether data should be transparent so that agencies could use it to compare and benchmark with one another. Some EMS agencies have expressed concern that they would find this level of identifiable data threatening, and they would not agree to sharing what they believe to be proprietary information. EMS needs to consider these issues and questions as part of a larger effort to advance an information-driven culture.

Conclusion

EMS has overcome a variety of challenges and positioned itself as a leader in standard data collection among the healthcare industry. NEMSIS, its supporting infrastructure and associated technology all have put EMS on the leading edge of data-driven decision-making. Looking forward, EMS must continue to move beyond data collection to identify how best to use data to create meaningful improvement within EMS and in the larger healthcare arena. The building blocks are in place to engage healthcare partners and patients more meaningfully. EMS also must seek to close the gap between the data collected and needed by researchers and public policy makers and what is valued by EMS agencies and field personnel. The project committee was truly inspired by the work accomplished at the Beyond Data summit and is encouraged by the thoughtful work that is being done on this issue by a diverse group of stakeholders. The way forward is to continue the conversation at all levels and to sustain ongoing dialogue with software developers who serve the industry.

The committee is hopeful that its work will be reflected in the revision of the *Agenda for the Future* and that stakeholders will continue to invest time and effort toward the development of creative approaches to the use of data and information in EMS.

Appendix A: Terms and Definitions

Component: An individual element, aspect, subgroup, or activity within a system. Complex systems such as EMS are composed of many components.

Data: Crude, isolated, non-analyzed measures that reflect the status or degree of a measured attribute of a component or system.

Electronic Health Records (EHR): In their simplest form, digital versions of patients' paper charts, also called Electronic Patient Care Records (ePCR). More broadly, EHR refers to an integrated dataset that includes the patient's medical history and treatment across multiple providers and allows for interoperability among various electronic systems.

EMS Compass Initiative: A Federally funded EMS project that is developing a core list of performance measures with specific definitions that are designed to improve quality, support accountability and enable comparison. The Initiative is led by the National Association of State EMS Officials and relies on NEMSIS Version 3 data elements to populate performance measures. This initiative continues the efforts of the EMS Performance Measures Project of the early 2000s.

Health Information Exchange: Electronic health information exchange (HIE) allows doctors, nurses, pharmacists, other health care providers and patients to appropriately access and securely share patients' vital medical information electronically.

Information: A combination of data, usually from multiple sources, used to derive meaningful conclusions about a system (health resources, costs, utilization of health services, outcomes of populations, etc.). Information cannot be developed without crude data. However, data must be transformed into information to allow decision-making that improves a given system.

Linkage: Connected; combining data from various sources to provide information that can be analyzed. This analyzed information allows meaningful inferences to be made about various aspects of a system. (An example would be linking EMS dispatch records, out-of-hospital patient care records and hospital discharge data.)

National Emergency Medical Services Information System: NEMSIS improves care through the standardization, aggregation, and utilization of point-of-care EMS data at the local, State, and national levels. It is often confused with one or more of its component parts, which include:

- National Uniform EMS dataset: A standardized set of definitions designed to describe an entire EMS event from activation of the EMS system through the release of the patient from EMS care. The latest dataset includes 578 elements.

- NEMSIS Data Dictionary: Standardized definitions for the national EMS dataset.

- NEMSIS Data Exchange (NDX): The portal used by State EMS agencies and EMS software vendors to submit data to the national EMS database.

- National EMS Database: An aggregated repository of EMS event data collected under the auspices of NEMSIS and housed at NHTSA.

- NEMSIS TAC: The Technical Assistance Center formed in support of NEMSIS, which provides aid to State EMS offices and electronic healthcare vendors that are responsible for gathering data and reporting it to the Federal NEMSIS repository. The NEMSIS TAC also supports institutions and individuals who desire to use NEMSIS data for research.

Outcome: The short, intermediate, or long-term consequence or visible result of treatment, particularly as it pertains to a patient's return to societal function.

Performance Measurement: The process of collecting, analyzing and reporting information about the performance of an individual, organization or system.

Real-time Patient Data: Current patient information provided by a field technician at the patient location to a physician or health care facility at a remote site, potentially for the purpose of assisting the physician to make a better informed decision on patient treatment and/or transport.

Research: The study of questions and hypotheses using the scientific method.

Appendix B: Timeline of Federal EMS Data Efforts

1991 American Heart Association publishes *Recommended Guidelines for Uniform Reporting of Data from Out-of-Hospital Cardiac Arrest: The Utstein Style*,[22] the first major document to specifically address EMS systems and their impact on patient outcome.

1993 Institute of Medicine report on *Emergency Medical Services for Children*[23] *s*tresses the need for reliable information as a basis for determining 1) the extent to which systems are providing appropriate, timely care or 2) what they should be doing to improve performance and patient outcome.

1994 NHTSA publishes *Uniform Prehospital EMS Dataset* that defines 81 elements important to an EMS information system.

1996 *EMS Agenda for the Future*[24] recommends that EMS adopt a uniform set of data elements and definitions to facilitate multisystem evaluations and collaborative research.

1997 National Center for Injury Prevention and Control publishes *Data Elements for Emergency Department Systems*[25] (DEEDS) targeting hospital emergency departments.

1998 NHTSA publishes *EMS Agenda Implementation Guide*,[26] which reinforces the need for a national EMS data system.

1999 NHTSA funds NASEMSD and EMSC to explore the feasibility of establishing a national EMS database.

2000 NASEMSD convenes a national focus group to discuss the establishment of a national EMS database.

2001 NHTSA and HRSA fund NASEMSD to develop the National EMS Information System

[22] Cummins et al., 1991.

[23] Durch, & Lohr, 1993.

[24] NHTSA,1996

[25] National Center for Injury Prevention and Control. (1997). Data elements for emergency department systems, release 1.0. Atlanta, GA: Centers for Disease Control and Prevention.

[26] Delbridge, T. R., Anderson, P. B., Aufderheide, T. P., Cason, D., Cooper, G. F., Glaeser, P., … & Waterman, M. (1998), EMS Agenda for the Future Implementation Guide (Report No. DOT HS 808 711). Washington, DC: National Highway Traffic Safety Administration. Available at www.ems.gov/pdf/advancing-ems-systems/Provider-Resources/EMS_Agenda_Imp_Guide.pdf

(NEMSIS).

2002 NEMSIS is launched. *Prehospital Emergency Care* publishes *EMS Information Systems and the Future of a National EMS Database*.[27]

2003 States and territories begin signing Memorandum of Understanding recognizing the need for standard EMS data collection at the State level as well as the assignment of specific definitions to a set of data elements identified as desirable to be collected on a national level. 400-page NEMSIS data dictionary is completed.

2004 Physical database schemas and models, as well as scripts to automatically create the database, are made available in different platforms to EMS software vendors and States implementing State EMS data collection systems. XML is defined as the standard to move EMS data between local and the State level or State and the national database level.

2005 A fully vetted dataset (Version 2.2) is released and schemas published on the NEMSIS website for integration. NHTSA, in cooperation with HRSA and the Centers for Disease Control and Prevention, enters into a cooperative agreement with University of Utah School of Medicine to operate the NEMSIS Technical Assistance Center (NEMSIS TAC).

2006 NEMSIS TAC begins testing software developers for NEMSIS compliance. Institute of Medicine National Academies of Science publishes *Emergency Medical Services at the Crossroads*.[28]

2009 NEMSIS Version 3 created, which not only expands the number of available NEMSIS data elements, it also provides standards for software implementation of business rules, expanded recommendations for State EMS datasets and a standard for data export using Web Services.

2012 NEMSIS version 3.2.6 is "locked down" and compliance testing of software products on the new standard begins. NEMSIS 3.x passes HL7 balloting and is now a normative standard. A Data Standard for Trial Use (DSTU) period is initiated and continues for 18 months.

2014 Joint National EMS Leadership Forum (JNEMSLF) reaches out to FICEMS and the NHTSA OEMS with a request that NHTSA create an *EMS Data Collection and Information Sharing Agenda for the Future*. NEMSAC recommends that FICEMS and NHTSA OEMS revise the 1996 *EMS Agenda for the Future.* FICEMS votes unanimously to revise the *EMS Agenda* with a focus on data-driven approaches to future improvements. FICEMS asks NHTSA to consider creating a national vision as to how EMS data can be collected and used to help drive EMS systems development and improvement at the local, State and Federal levels.

EMS Compass Initiative launches to tie national EMS data elements to evidence-based quality

[27] Mears, Ornato, & Dawson, 2002.

[28] Committee on the Future of Emergency Care in the United States Health System. (2007). Emergency Medical Services at the Crossroads. Washington, DC: National Academies Press. Available at www.nap.edu/catalog.php?record_id=11629

and performance measures for local agencies. The project is funded by NHTSA through the National Association of State EMS Officials and envisions a long-term connection among NEMSIS, performance measures and evidence-based guidelines implementation.

2016 Forty-eight States and territories collect EMS data consistent with NEMSIS Version 2. Version 3 is being adopted nationwide. End of the year marks the final date in which data may be collected under Version 2. NHTSA OEMS wants to better understand the role of data in EMS as part of its efforts to revise the 1996 *EMS Agenda for the Future*[29] and hosts summit meeting.

[29] NHTSA, 1996.

Appendix C: NEMSAC Advisory on NEMSIS

In 2013, the National EMS Advisory Committee published an Advisory paper in which it studied the effectiveness of NEMSIS to date. In that paper, NEMSAC made the following observations and recommendations:

"The implementation of NEMSIS has served to address an important, long-standing call for quality, comprehensive documentation of EMS response, treatment, stabilization, and transport of patients. There is a wealth of potential opportunity for NEMSIS to positively influence not just EMS, but the broader healthcare enterprise through the following outcomes: improved patient care, enhanced patient care coordination, ensured EMS workforce safety and training, reduced healthcare spending, advised healthcare reform, and high quality research, with the goal of improving the care and outcome of acutely injured or ill patients. However, this vision has not been fully realized nor have the necessary supporting mechanisms been available at the national, State, and local levels for EMS stakeholders to achieve the full potential of NEMSIS to improve healthcare quality."

Recommended Actions/Strategies

The NEMSIS should be supported as the continued, recognized, official national standard for EMS data. Efforts should be made to mitigate the challenges to using NEMSIS for healthcare improvement through the following tasks:

The National Highway Traffic Safety Administration

- **Recommendation #1**: NHTSA should identify and categorize existing EMS performance measures, particularly those that use NEMSIS compliant data, and make them available from a central repository. Such efforts should combine/compile existing performance measures, adding measures that are more easily captured with data compliant to NEMSIS V3 such as time sensitive conditions. Examples of how national and professional organizations could use and assess each performance measure should be provided.

- **Recommendation #2**: NHTSA should develop mechanisms to assist State EMS Offices and local agencies in employing NEMSIS performance measures. These could include an EMS quality improvement and performance measure guidelines, a series of standardized reports, or report cards, with a focus on quality and outcomes and characterize clinical success, procedure success, areas for improvement, and patient status upon ED discharge (i.e., outcomes). There could also be provided technical benchmarking guidelines for software/database/report developers that facilitate the use of State and national information to be compared with local data.

- **Recommendation #3**: NHTSA should identify barriers to the real time surveillance of local and State EMS data (i.e., dashboards) to be used for quality improvement and compliance with NEMSIS.

- **Recommendation #4**: NHTSA should build upon this document to further develop and publicize a vision for using NEMSIS for healthcare system improvements and research, including best practices for implementation, collection, and further utilization of EMS data, highlighting successful programs/attributes of State systems that are integrating EMS data to serve local and State public health and public safety needs.

- **Recommendation #5**: NHTSA should identify the necessary knowledge, skills, and abilities for EMS systems staff to adequately and properly collect NEMSIS compliant data, analyze these data, and develop meaningful and actionable outputs.

The Federal Interagency Committee on EMS

- **Recommendation #6**: FICEMS should lead the effort in supporting and establishing technical and political solutions that encourage and enable State and national datasets (i.e., healthcare, traffic, public health) to be "linked" with NEMSIS-compliant data to enrich the descriptions and to understand the determinants of "healthcare events" experienced by individual patients or related to disaster situations.

- **Recommendation #7**: FICEMS should support the development of administrative and political (e.g., sample State legislation) strategies that facilitate the use of NEMSIS data in public health/ public safety surveillance.

- **Recommendation #8**: FICEMS should work with member agencies to revisit opportunities for incorporating language into Federal grant guidance that aligns with the FICEMS position statement set forth in 2008, calling for Federal funding to support the establishment and development of NEMSIS compliant information systems in addition to the transition to NEMSIS V3.

- **Recommendation #9**: FICEMS should work with its member agencies to ensure the use of the NEMSIS data standard in the development of EMS related performance measures for reimbursement.

- **Recommendation #10:** FICEMS should work with its member agencies to use NEMSIS data and information systems to respond to the Gap Analysis of EMS Related Research, as well as to achieve program objectives when developing strategic direction or grant guidance related to emergency care topics, including preparedness and mass casualty incidents.

Appendix D: Reading List

Federal Documents:

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McLean, S. A., Ronald F. Maio, R. F., Spaite, D. W., & Garrison, H. G. (2002, January). Emergency Medical Services Outcomes Research: Evaluating the Effectiveness of Prehospital Care. Prehospital Emergency Care 6(2 Suppl):S52-6. Available at www.researchgate.net/profile/Samuel_Mclean/publication/-11404355_Emergency_Medical_Services_Outcomes_Research_Evaluating_the_Effectiveness_of_Prehospital_Care/links/0c9605166f55158f13000000.pdf?origin=publication_detail

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