

# PERFORMANCE MEASUREMENTS IN EMERGENCY MEDICAL SERVICES

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## ABSTRACT

With the strong encouragement of leading health care agencies, business principles are being implemented throughout health care, including emergency medical services (EMS). The reason is simple—quality of care can be enhanced by incorporating the management concepts of continuous quality improvement (CQI). The CQI process couples carefully identified, measurable performance indicators with information systems to monitor, analyze, and trend data. Benchmarking outcomes with other EMS systems allows the identification of “best practices” and the evolution of standards. Emergency medical services professionals must actively participate with the broader health care community in creating performance measurements to ensure that high-quality care is delivered consistently. **Key words:** continuous quality improvement; emergency

medical services; performance measurements; performance indicators; standards.

## PREHOSPITAL EMERGENCY CARE

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Practices common to American business more than 30 years ago are increasingly being applied to the health care industry today. The public now expects the quality and consistency of health care to be evaluated by using performance measures analogous to those used by traditional service industries, such as retail stores, automobile manufacturers, and hotels. A recent Institute of Medicine publication titled *Crossing the Quality Chasm* stated that the U.S. health care system is “broken” and advocated for fundamental change through the implementation of continuous quality improvement (CQI) activities.<sup>1</sup> Growing public concern over the alarming rates of preventable medical errors has reinforced the need for processes that can be used to identify and correct systemic error.<sup>2</sup> The quality of health care can be defined and measured with a degree of scientific accuracy comparable to that of most analytic measures used in clinical medicine.<sup>3</sup> As an integral

component of the health care system, emergency medical services (EMS) administrators must develop CQI strategies to ensure confidence in the quality of their systems.

In 1998, The President’s Advisory Commission on Consumer Protection and Quality in the Health Care Industry offered general recommendations for quality measurement and reporting in health care (Table 1).<sup>4</sup> Keeping these basic recommendations in mind, EMS administrators must now begin to select performance measurements that reflect their essential services and benchmark outcomes; they must also champion “best practices” and promote the evolution of evidence-based standards of care. Quality can no longer be assumed—it must be managed. Further, the adage “you can only manage what you can measure” is truer today than ever before.

## CONTINUOUS QUALITY IMPROVEMENT IN EMERGENCY MEDICAL SERVICES

Although quality itself may seem elusive, in 1990 the Institute of Medicine defined quality in health

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TABLE 1. Recommendations for Quality Measurement and Reporting in Health Care\*

- Identify sets of quality measures for standardized reporting by each sector of the health care industry.
- Develop a framework for quality measurement and reporting and standardization of quality reporting.
- Support the development of quality measures to enhance the ability to evaluate and improve health care.
- Determine stable mechanisms for quality measurement and reporting.
- Ensure that information about health care quality is valid, reliable, comprehensible, and available to the public.

\*Source: The President’s Advisory Commission on Consumer Protection and Quality in the Health Care Industry. Quality First: Better Health Care for All Americans; Final Report to the President of the United States. Washington, DC: U.S. Government Printing Office, March 1998.

care as “the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.”<sup>5</sup> Until recently, measuring quality in health care often involved quality assurance techniques. Although it provides useful information, quality assurance is typically static, retrospective, implemented by management, and clinician-focused. Chart audits can identify protocol deviations<sup>6</sup> or individual or event-based failures<sup>7-9</sup> but lack the ability to maintain and enhance performance. As the value of CQI (developed in the late 1940s by W. Edwards Deming for business management<sup>10</sup>) was recognized by the health care industry in the mid-1980s, the means of measuring quality shifted from the inspection approach of traditional quality assurance to the analytical approach of CQI. The CQI method emphasizes organizational systems and processes rather than individual behavior as targets for data collection, analysis, and improvement. By evaluating specific indicators of performance, assessing the processes associated with these performances, and implementing solutions to inadequate systems, CQI both addresses current problems and prevents future occurrences by resolving the problem source.

By 1992, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) was strongly encouraging health care organizations to implement CQI as a means to more accurately provide information regarding the needs of patients and other stakeholders. A modified JCAHO hospital model was suggested for use in EMS,<sup>11</sup> and the American College of Emergency Physicians,<sup>12</sup> the National Association of EMS Physicians,<sup>13</sup> and the National Highway Traffic Safety Administration (NHTSA)<sup>14</sup> endorsed CQI for EMS. By the mid-1990s, it was

clear that a process for continuously evaluating the quality of EMS (one that also allowed for rapid insertion of improvements into the system) was required. The challenge remains to identify the most important aspects of care and to develop a method to measure and monitor them.<sup>15,16</sup>

To develop a foundation and framework, NHTSA funded a five-year project called the Emergency Medical Services Outcomes Project (EMSOP). The EMSOP is designed to identify: 1) conditions that should take precedence in EMS outcomes research; 2) risk adjustment measures for these priority conditions; and 3) outcome measures for these priority conditions. In EMSOP phase I, Maio et al.<sup>17</sup> identified “relief of discomfort” as the clinical indicator with the greatest potential benefit for implementation in a CQI process. The authors endorsed the use of “tracer” conditions (those with high frequency and a high potential to benefit from medical care)<sup>18</sup> as indices of an EMS system’s overall effectiveness. In EMSOP phase II, Spaite et al.<sup>19</sup> described the need for different EMS outcome models based on the severity and therapeutic time dependency of particular conditions. For example, the impact of prehospital care on nontraumatic cardiac arrest, airway obstruction, anaphylaxis, respiratory arrest, and possibly severe trauma can be analyzed with outcome measures such as survival or change in physiologic status. Outcome analyses for conditions with less time-critical elements (e.g., painful extremity injury) are better modeled by defining and measuring delivery of discrete “units of service,” such as pain relief and patient satisfaction.

### DESIGNING AND IMPLEMENTING CONTINUOUS QUALITY IMPROVEMENT

In the 1996 landmark publication *EMS Agenda for the Future*, NHTSA defined an EMS system as a dedi-

TABLE 2. Emergency Medical Services Attributes Recommended by the National Highway Traffic Safety Administration for Inclusion in Continuous Quality Improvement Programs\*

- Clinical care
- Communications systems
- Education systems
- Emergency medical services research
- Evaluation
- Human resources
- Information systems
- Integration of health services
- Legislation and regulation
- Medical direction
- Prevention
- Public access
- Public education
- System finance

\*Source: National Highway Traffic Safety Administration. *Agenda for the Future* (DOT HS 808 441). Washington, DC: U.S. Department of Transportation, August 1996.

cated organization for the allocation and coordination of emergency medical personnel, protocols, equipment, and supplies.<sup>20</sup> The report concluded that to operate in an efficient manner, EMS systems must have comprehensive assessment programs in which current processes are reviewed and improved as necessary. To assess the effectiveness of an EMS system, administrators should gather data relevant to current standards or expectations to validate existing processes or identify areas for change. Any redesign or implementation of a new process should also be evaluated with relevant performance measures. In the *EMS Agenda for the Future*, NHTSA identified 14 attributes that should be included in a CQI program (Table 2).<sup>20</sup> They also emphasized the value of input from local health care professionals and the community in developing relevant CQI indicators and suggested that outcome categories, such as cost-effectiveness, specific interventions analysis, and systems readiness, could be disseminated in a report-card format to inform the public and EMS providers of the status of their system. It was also recommended that legislative safeguards

TABLE 3. Evaluation Recommendations for the California Emergency Medical Services (EMS) Authority Proposed by a Technical Advisory Team of the National Highway Traffic Safety Administration (NHTSA)\*

- **Develop a comprehensive, medically directed statewide quality improvement program to evaluate patient care processes and outcomes.**
- **Develop a statewide integrated information system that will have the ability to monitor, evaluate, and elucidate EMS and trauma care in California.**
- Ensure the design capability for linkages of the statewide integrated information system to other public and private data systems.
- **Allocate personnel and resources to implement the statewide integrated information system, including necessary technical assistance, materials, and funding to local EMS agencies.**
- Enforce the use of a uniform prehospital data set consistent with NHTSA Uniform Prehospital Data Set. Mandate submission of an agreed on, timely, limited, uniform, common language data set from the local EMS agencies to the California EMS Authority.
- Seek ways to improve the number of completed care records that are delivered to the emergency department staff on patient arrival, with a goal of 98% compliance.
- Request that NHTSA conduct the Leadership Workshop on Quality Improvement for EMS systems in California.
- **Write and help shepherd through the legislative process legislation to ensure the confidentiality and non-discoverability of EMS and trauma records and EMS provider protection while participating in EMS quality improvement activities.**
- Promote and support decreasing barriers to performing EMS research in California. Vigorously develop a statewide human subjects review approval process for out-of-hospital research.

\*Boldface indicates a priority recommendation. Source: Bass RR, Conn AK, Dawson D, et al. State of California: An Assessment of Emergency Medical Services. Report of the National Highway Traffic Safety Administration Technical Assistance Team, August 23–26, 1999. Available at: <http://www.emsa.ca.gov/vision/nhtsarpt99.asp>.

be established to protect EMS medical directors and field personnel from liability resulting from a review of unexpected or unusual situations. In follow-up publications, NHTSA proposed CQI templates and techniques to implement these recommendations.<sup>21</sup> The companion document *EMS Agenda for the Future: Implementation Guide* offers examples of the tools, infrastructure, and strategic partnerships necessary to accomplish short, intermediate, and long-term *EMS Agenda* objectives.<sup>22</sup>

While NHTSA continues to address EMS quality improvement at a national level, individual states have begun analyzing their current quality improvement processes as well. As a component of its Vision for EMS project, the California EMS Authority, in concert with the Office of Traffic Safety, invited a technical assistance team from NHTSA to evaluate its EMS program and make recommenda-

tions.<sup>23</sup> The team compared current standards, present status, and future goals in ten essential areas of EMS and prioritized recommendations for improvement (Table 3). As a result, a series of voluntary statewide performance indicators is currently being evaluated.<sup>24</sup>

### STANDARDS, PERFORMANCE INDICATORS, AND BENCHMARKING

Although the terminology for assessing EMS systems varies, the definitions provided in Table 4 are commonly used. Measures of system performance are traditionally based on three elements—structure, process, and outcome.<sup>11,13,25</sup> The JCAHO refers to “dimensions of performance,” which encompasses measures of efficacy, appropriateness, availability, timeliness, effectiveness, continuity of care, safety, efficiency, and respect and caring.<sup>26</sup> The acronym SMART

refers to the features of effective performance measurement tools; they should be specific, measurable, action-oriented, relevant, and timely.<sup>27</sup>

Structural assessment consists of the straightforward evaluation of the environment in which care is delivered.<sup>13</sup> Examples include facilities, equipment, and provider training and knowledge base.<sup>11,13,25</sup> A structural indicator could also be used to monitor EMS staff credentialing.<sup>11</sup> Structural indicators are the most difficult element to relate to outcomes.<sup>25</sup>

Process assessment typically analyzes the actions taken by both the provider and the patient and is evaluated by indicators of discrete steps in requesting and providing care. A process indicator, for example, could consist of measuring the appropriate steps for administering bronchodilator therapy to a patient with reactive airway disease. Although process does not necessarily affect outcome, the definition could be expanded to include the repeatable sequence of steps performed by all levels of the EMS system to effect a good outcome.<sup>25</sup>

Outcome measures, both final and intermediate, assess the effect of care on the overall health, satisfaction, knowledge, and behavior of the patient. Outcome indicators should assess whether the integrated elements of the system function to achieve the desired effect.<sup>17,25</sup> An example of an outcome indicator would be the consistent attainment of pain relief through the appropriate use of parenteral analgesics.

Benchmarking entails the use of a structured method to quantitatively compare processes or products with the goal of identifying current best practices. Benchmarks may eventually become best practices or industry standards. However, the superiority of one practice over another may depend on the criteria used to test it.<sup>25,28</sup> For example, best practices might differ when evaluated for cost-effec-



tiveness rather than patient outcome. With patients increasingly expecting service and value both in and outside the health care industry, it may be appropriate to consider adopting certain EMS benchmarks from other service industries.<sup>28</sup> In particular, there are many parallels between EMS and the hotel and restaurant industries regarding customer service, telephone protocol use, and staff training.

### PRACTICALITIES OF STANDARDS AND PERFORMANCE INDICATORS

Until recently, EMS physicians and administrators usually set EMS standards, often by consensus without the benefit of research or validation of indicators.<sup>25</sup> Several nongovernmental organizations, including the American Society for Testing and Materials, the Commission on Accreditation of Ambulance Services, and the Joint Review Committee on Education Programs for Emergency Medical Technicians and Paramedics, have developed voluntary standards. The impact of these voluntary standards has been limited largely because of a lack of validation.

Also, to achieve uniformity in diverse EMS systems, standards and performance indicators may need to be defined by state or federal legislators.

Recently, significant efforts to implement quality measurement tools have been made by fire services, including the International Association of Fire Fighters (IAFF), the International Association of Fire Chiefs, the National Fire Protection Association (NFPA), and the Commission of Fire Accreditation. The IAFF has developed a pilot set of quality indicators (Table 5)<sup>29</sup> and a three-part pilot performance measurement instrument.<sup>30</sup> Each indicator is defined, measurement methods are discussed, existing standards are referenced, and EMS system goals are proposed. The IAFF performance measurement tool is currently being tested in more than 250 U.S. cities to assess the EMS performance goals contained in the recently approved NFPA document (NFPA 1710) on standards for the organization and deployment of fire suppression operations, emergency medical operations, and special operations to the public by career fire departments.<sup>31</sup> The NFPA 1710 document and its sister

TABLE 5. Quality Performance Indicators Proposed by the International Association of Fire Fighters\*

- Call processing
- Turnout time
- Travel time
- Staffing
- Deployment
- Road structure coverage capability
- Patient care protocol compliance
- Patient outcome
- Defibrillation availability
- Extrication capability
- Employee illness and injury
- Employee turnover
- Quality program
- System user opinion
- Multi-casualty event response plan

\*These performance indicators are currently being tested in cities across the United States. Adapted from: Moore L. Prehospital EMS System Performance Measures: Quality Indicators. Washington, DC: International Association of Fire Fighters, 2001.

publication NFPA 1720 set minimum criteria for response times, staffing, and quality assurance for all paid and volunteer fire departments. A companion NFPA 1221 publication sets dispatch standards, recommending, for example, that calls be answered at the public service answering point within 30 seconds and subsequently dispatched within 60 seconds. Finally, the Commission of Fire Accreditation is assessing the feasibility of establishing a commission whose purpose would be to accredit fire-department-based EMS systems.

Nowhere is the task of measuring quality more difficult than in creating valid structural indicators of an EMS provider's clinical competency. In 1998, the Milwaukee County EMS system described minimum biennial paramedic performance standards using counts of patient contacts, runs as team leader, endotracheal intubations, defibrillations, intravenous line initiations, and medications administered.<sup>32</sup> In Pittsburgh, EMS administrators found it valuable to ask paramedics to select quality indicators.<sup>33</sup> In addition to traditional indicators of performance, such as success rates of procedures, proto-

TABLE 4. Terms Commonly Used in Assessment of Emergency Medical Services Systems

**Structure**—measure that assesses whether organizational resources and arrangements are in place to deliver health care, such as the number, type, and distribution of medical personnel, equipment, and facilities; the interrelated components forming a system.

**Process**—interrelated series of events, activities, actions, mechanisms, or steps that transform inputs into outputs; the system of task, workflow, information flow, and other interdependencies that produce some specific outputs or results; how work is done, how outputs or results are achieved, and how value is provided to the business or customer.

**Outcome**—measure that indicates the result of the performance (or nonperformance) of a function(s) or process(es).

**Benchmarking**—structured method of measuring processes and products against each other to identify and understand the characteristics of superior performance ("best practices").

**Customer**—recipient or beneficiary of the output of work effort or purchaser of products; can be either internal or external to the organization and must be satisfied with the outputs of the work effort.

**Performance indicator**—measurable characteristic of a product, service, or process that best represents quality and customer satisfaction.

**Practice**—technique or method used to perform a step in a particular process.

**Standard**—quantitative marker for comparing acceptable performance.

col deviations, and response times, the paramedics' suggestions included crew and equipment appearance and internal satisfaction.

Performance measures in EMS are likely to improve service delivery when providers both understand and endorse them. Joyce et al.<sup>34</sup> demonstrated system-wide improvements in 13 of 19 performance indicators when results of these indicators, including protocol compliance, time elements of response, and triage and transport elements, were routinely circulated to providers and training was offered.

Traditional public health outcome indicators measure the "6 Ds": death, disease, disability, discomfort, dissatisfaction, and destitution. Emergency medical services systems have infrequently used all these outcomes, instead focusing most often on survival. Unfortunately, other than survival after sudden cardiac arrest<sup>35</sup> or major trauma,<sup>36</sup> little or no evi-

dence-based EMS outcomes data exist.<sup>37</sup>

For the CQI process to work, data must be reliable, uniform, and accurate.<sup>38-40</sup> A number of EMS systems have demonstrated the value of integrated computer-assisted quality assurance programs in performance evaluations.<sup>41-43</sup> Computer analysis can help personnel objectively focus on deficiencies and strengths, as well as compare and suggest improvements in specific performance indicators.<sup>44</sup> Computerized data collection and analysis have also been extended to evaluation of system costs and resource allocation for quality improvement programs.<sup>41</sup>

## CONCLUSION

Measuring the quality of care and implementing processes to improve this care have become a top priority for many EMS systems across the United States. The accepted quality management tools that have long been integral

to service industries must be adapted to federal, state, and local EMS needs. At each level, EMS leaders must begin the process of defining the structural, process, and outcome performance measures critical to their organizations. They should consider what the patients value and create methods to ensure that goals are being met. Each performance indicator must be linked to an essential aspect of excellence, and each EMS provider contributing to that indicator must understand its significance. Those responsible for administering EMS systems must ensure the budget needs of the information systems and personnel required to support this process. As part of the CQI cycle, the results of initial research efforts must be effectively shared with providers and the public. The ultimate result of defining valid EMS performance measurements today will be the ability to demonstrate the value and quality of EMS care tomorrow.

## CONSENSUS PRESENTATION

The first recommendation from the consensus group was to use the term *performance measurements* rather than performance standards for EMS systems. There is a paucity of literature available in this area to support a choice of standards. Although some standards have been published, they lack the desired evidence-based support that should be a requirement for determining current or future standards. The consensus participants overwhelmingly agreed that all EMS systems should be using some form of performance measurements to set, evaluate, and implement standards of care. One of the first steps in beginning this process is to support EMS data collection through the establishment of enabling legislation at the state level. The participants also supported the position that such legislation should provide confidentiality for CQI review to protect these data and allow the process to work without fear of liability.

### DEVELOPING PERFORMANCE MEASUREMENTS

Although the goal of choosing, using, and evaluating performance measurements to achieve benchmarks and eventually best practice guidelines is worthwhile, some of the basic needs of the process are still missing. Definitions within EMS often vary widely, affecting the validity of within-system and cross-system comparisons of outcomes. For example, the beginning and end of the response time interval are not consistent across systems. Urban, suburban, rural, and frontier EMS systems each require specific performance measurements to ensure consistency. The level of staff training and experience varies, as some systems are staffed by basic emergency medical technicians, while others are sup-

ported by multiple paramedics on each incident.

Performance measures are also affected by changes in structural variables. For example, first-responder defibrillation capability is an important structural component, but the widespread implementation of public-access defibrillation programs might change that someday. A challenge to EMS medical directors in the era of cost-effectiveness is ensuring that performance measurements are grounded by sound clinical decisions. The consensus group also reinforced the need to consistently apply appropriate statistical methods to all CQI activities.

### CATEGORIES OF PERFORMANCE MEASUREMENTS

The consensus participants discussed several areas in which performance measurements should be established; these included regulation and policy standards, resource management, human resources and training, transportation, facilities, communications, medical direction, trauma systems, and evaluation. Within each of these categories, numerous areas were identified that could be targeted for specific performance measurements, such as dispatch intervals, peripheral intravenous success rates, response times for adult cardiac arrest, ambulance diversion, preventable deaths, chart documentation, and patient satisfaction.

### CONCLUSION

Although discussion of specific performance measurements was beyond the scope of the consensus group given the time constraints, the participants strongly recommended that EMS systems develop performance measurements. To provide consistency and allow for comparisons, uniform definitions

must be established and accepted. Variations in EMS systems and environments must be considered when setting standards and applying performance measurements. Because EMS lacks an oversight organization such as the JCAHO to drive the CQI agenda, EMS medical directors, administrators, and providers must take the initiative to develop and evaluate their own performance measurements to meet the expectations of the community for quality care.

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