EVIDENCE-BASED PERFORMANCE MEASURES FOR EMERGENCY MEDICAL SERVICES SYSTEMS: A MODEL FOR EXPANDED EMS BENCHMARKING

A STATEMENT DEVELOPED BY THE 2007 CONSORTIUM U.S. METROPOLITAN MUNICIPALITIES' EMS MEDICAL DIRECTORS (APPENDIX)

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ABSTRACT

There are few evidence-based measures of emergency medical services (EMS) system performance. In many jurisdictions, response-time intervals for advanced life support units and resuscitation rates for victims of cardiac arrest are the primary measures of EMS system performance. The association of the former with patient outcomes is not supported explicitly by the medical literature, while the latter focuses on a very small proportion of the EMS patient population and thus does not represent a sufficiently broad selection of patients. While these metrics have their place in performance measurement, a more robust method to measure and benchmark EMS performance is needed. *The 2007 U.S. Metropolitan Municipalties' EMS Medical Directors' Consortium* has developed the following model that encompasses a broader range of clinical situations, including myocardial infarction, pulmonary edema, bronchospasm, status epilepticus, and trauma. Where possible, the benefit conferred by EMS interventions is presented in the number needed to treat format. It is hoped that utilization of this model will serve to improve EMS system design and deployment strategies while enhancing the benchmarking and sharing of best practices among EMS systems.
Key words: emergency medical services; paramedics; performance improvement; quality assurance; evidence based medicine; STEMI, acute myocardial syndrome; asthma; pulmonary edema; status epilepticus

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INTRODUCTION

Evidence-based clinical measures of emergency medical services (EMS) system performance have been few in number, largely due to the limited quantity and quality of research committed to the prehospital arena.[1–4] Although there is a 9-1-1 call for EMS response every other second in the United States, and despite the fact that survival from various acute illnesses and injuries are determined in that prehospital setting, evidence for out-of-hospital emergency care procedures are clearly lacking.[1–3] This paucity of prehospital research is due to a number of factors, including the relatively young age of EMS as a distinct field of medical care, difficulties in terms of obtaining informed consent and accurate data collection in the prehospital environment, lack of targeted funding, the small number of dedicated EMS-focused researchers, inconsistencies in investigational protocol compliance, and actual or perceived resistance to participation in research by EMS personnel and receiving facilities.[2–4]

In the absence of a distinct body of literature evaluating the full spectrum of medical interventions provided in the prehospital setting, EMS performance measures have been limited to the relatively few benchmarks that have been established scientifically, such as survival from out-of-hospital cardiac arrest.[5,6] Although treatment of cardiac arrest represents a major function of most EMS systems, it only constitutes a small fraction (1–2%) of all EMS responses. Lacking data, other performance standards generally have been based on measures of nonclinical endpoints and inconclusive, surrogate clinical markers, such as response intervals and training standards. In most cases, crude measures of stakeholder satisfaction (surveys) and other anecdotal measures are utilized to judge the performance of EMS systems.[3]

Even when implemented, utilization of such performance measures for the purposes of establishing system benchmarks is also limited by a lack of common definitions and other standardized nomenclature for data elements and clinical outcome endpoints.[6–9] In many EMS systems, response-time intervals and rates of cardiac arrest survival to the point of hospital admission are the primary measures reported in analyses of system performance.[5,6] However, despite many published attempts to standardize those data, the definition of response interval and survival still remain nonuniform when reported.[5–10]

In an attempt to begin a process that will expand the list of evidenced-based EMS performance measures and to do so with uniform definitions and reporting standards, the *2007 Consortium of U.S. Metropolitan Municipalities' EMS Medical Directors'* reviewed the available scientific literature and, accordingly, developed an applicable consensus statement. The following discussion is the written product of that consensus process, which was formally developed during the Consortium's symposium in February 2007, similar to previous consensus documents.[11] Specifically, the discussion will address some of the common performance measures currently in use, and it will also describe a new model for more appropriate evidence-based benchmarking and performance measurements in large urban and suburban EMS systems.

Traditional Performance Measures

Response Time Intervals

EMS system response-time intervals are attractive quality measures, as they are easily quantifiable, objective, and readily understood by both the public and policy makers. Much of the public's day-to-day expectations in 9-1-1 emergency situations, regardless of true time-dependency of the clinical scenario, is based on how soon responders arrive and attend to their family members.[12] Overemphasis upon response-time interval metrics may lead to unintended, but harmful, consequences (e.g., emergency vehicle crashes) and an undeserved confidence in quality and performance. First, much of the clinical research utilized to establish an acceptable "advanced life support (ALS) response time interval" was conducted in a period when only paramedics could operate a defibrillator, and the compression component of basic cardiopulmonary resuscitation (CPR) received much less emphasis.[13] Now that basic life support (BLS) providers and lay rescuers can provide rapid automated defibrillation as well as basic CPR, the relative importance of the ALS response-time interval has been challenged, both for cardiac arrest as well as for other clinical conditions.[14–23]

Nevertheless, in many EMS systems, the ALS response-time interval, rather than that of the nearest CPR and automated external defibrillator (AED)-equipped unit, remains the focus of system performance and enhancements. Many communities are still not measuring the intervals for the most important predictive elements for optimal outcome: time elapsed until initiation of basic chest compressions and time elapsed until defibrillation attempts.[15,24]

For the purposes of benchmarking response times must also be measured using the same standard in all EMS systems.[25–29] Current *National Fire Protection Association* (NFPA) standards measure response intervals as beginning when the responding EMS unit reports that it is enroute and ending when the unit reports to be "on-scene" (at the address of record and not necessary at the patient's side). Accordingly, as a national standard, many EMS systems use this definition.[30] However, from a physiological (and bystander) point of view, a better measure of an appropriate response interval would be the time elapsed from the moment that the telephone rings at the 9-1-1 call center until the responding personnel with a defibrillator make actual patient contact or deliver the shock. This is particularly important when access to the patient is delayed from arrival at the street-address location, as in urban high-rise structures or in mass gathering events with logistical barriers.[31] Accordingly, we are placing more of an emphasis on time elapsed to the actual medical care interventions rather than surrogate variables of EMS response-time intervals.

Traditionally, managers of EMS systems that focus on response-time interval goals often determine that they must either add paramedics to the system or increase the efficiency of EMS units currently being deployed. As more paramedics are added to a particular system, however, the frequency with which each individual paramedic has the opportunity to assess and manage critically ill or injured patients in the primary or "lead" paramedic role may decrease. Pragmatically, considering that ALS cases constitute a small minority of all EMS 9-1-1 responses, adding more paramedics into the system may actually reduce an individual paramedic's exposure to critical decision-making and clinical skill competencies.[32–36] Additionally, in order to enhance system efficiency, scarce financial resources must be expended on technologic or operational solutions, such as automated vehicle location (AVL) technologies, adoption of sophisticated computer aided dispatch (CAD) systems, and/or system status management (SSM) plans. Such high-level technology solutions have their place, but their relative importance in terms of improving outcome and EMS system quality should be kept in context. Specifically, these technologies are often deployed only for the ALS response element, rather than for the evidenced-based, time-dependent response interval of the basic CPR and AED-equipped BLS element.

Ultimately, each community must evaluate response-time interval goals not only in the broader context of satisfying public policy and public expectations, but also in terms of protecting both the driving and pedestrian public as well as what is best for the patient, their family, and the ultimate outcome of the sick and injured. Ideally, the response-time interval goals to which an EMS system should be held accountable should have as much clinical significance as political relevance. With the exception of basic CPR and AED response (in the case of cardiac arrest), there is insufficient evidence to strongly recommend a specific *ALS* (paramedic) response-interval target as part of an evidence-based model for performance evaluation of an EMS System.[15,18,19]

In terms of ALS transport-time intervals, there have been some inferential survival data that may demonstrate the importance of ALS and transport times following post-traumatic circulatory arrest.[37,38] When paramedics provided definitive prehospital airway management, they extended the time interval that such patients will tolerate pulselessness and CPR conditions until emergency thoracotomy.[37,38] However, there is no hard and fast scientific evidence (e.g., controlled studies) that explicitly proves this particular measure of performance.

Out-of-Hospital Cardiac Arrest Survival Rates

The probability of survival to emergency department arrival for out-of-hospital cardiopulmonary arrest patients is directly related to a multifactorial performance of the EMS system. Such factors include response intervals for BLS and AEDs, immediate performance of basic CPR by bystanders, and the many dynamic variables that drive those factors, such as efficiencies in dispatch operations, quality assurance of protocols for first responders, community AEDs, and CPR training programs.[6,16,17] Therefore, while such cases represent only 1–2% of 9-1-1 calls for medical emergencies, it is appropriate to devote sufficient resources for these responses. Also, this particular measure involves dramatic, highly visible life-saving outcomes for many persons in their prime of life and middle age, thus carrying significant weighting in the spectrum of EMS system duties.

Nevertheless, measuring EMS system performance solely on this aspect of EMS activities does not provide a complete picture of clinical performance for the other 98% of EMS 9-1-1 responses. Also, depending on the definition used for a performance measure of survival (e.g., “survival to hospital admission,” “survival to discharge,” or “neurologically intact survival”), final outcomes may not be fully attributable to prehospital care alone.[39]

In addition to these difficulties, one must account for the differences between rural, suburban, and urban EMS systems. An AED response time interval goal of five minutes from first 9-1-1 center call receipt to arrival at the patient’s side may be reasonable for a relatively low-volume suburban community EMS agency with well-positioned first responders. This same goal, however, may be fiscally or logistically impossible for a rural community with very low population density or physically impossible for an urban community with significant vertical response-time delays.[40,41]

In essence, while the traditional performance measures of response intervals and cardiac arrest survival have clear value, they also have their limitations. They also do not fully reflect clinical performance (or are inapplicable) in the great majority of EMS responses. There are many other opportunities for performance measurements, ranging from evaluation and documentation of treatments for myocardial infarction and status epilepticus to respiratory distress and traumatic injuries, just to name a few of the other critical clinical scenarios. Therefore, it is recommended that a more expanded model of performance be considered to evaluate EMS systems in addition to cardiac arrest survival.

Proposed Model for Clinical Performance Benchmarking

The purpose of the following discussion is to provide a framework for improved benchmarking of performance in large suburban and urban EMS Systems based on currently available evidence. While the role of the emergency medical dispatcher is critically integral to the overall performance of an EMS system, this discussion is focused primarily upon the hands-on medical care provided to patients and thus does not include performance elements related to dispatch. Accordingly, essential elements of patient care interventions and management for several key clinical presentations are central to the proposed model.

In many cases, there may be only evidence for a complete spectrum of care, rather than validation for each isolated clinical intervention. For example, evidence suggests that nebulized beta agonists and sublingual nitroglycerin each significantly reduce mortality for certain patients in respiratory distress.[42] In contrast, in the case of flash pulmonary edema/congestive heart failure (CHF), the evidence regarding improved patient outcomes with the provision of ALS (paramedic level support) versus limited BLS care is quite compelling. Still, it is not yet possible to describe the relative benefit of any single ALS treatment modality in isolation that those paramedics provide.[42] The same is true for cardiopulmonary arrest scenarios not requiring countershocks (e.g., cases presenting with asystole, pulseless electrical activity).[43] It is clear that ALS support overall can be life-saving, but it is not clear which individual interventions contribute to (or even detract from) the positive survival rates. Accordingly, for some clinical entities, the magnitude of benefit is associated with a “treatment bundle.” In these cases, it is likely that patients receive some benefit from at least one or more of each individual suggested intervention, but, based on available science, the reported benefit may only be conferred if all elements of the bundle or management strategy are provided.

Additionally, in some clinical situations for which improved outcomes have been demonstrated in large-scale trials, the key issue is to provide the proven therapy, bundled or not, and to document its timely implementation. The treatment of ST-Elevation Myocardial Infarction (STEMI) is an exemplary consideration of bundling treatment interventions with applicable management strategies (e.g., destination hospital protocols) along with documentation of timely interventions.

ST-Segment Elevation Myocardial Infarction (STEMI) Performance Measures

Based on the best available evidence, the most recent *American College of Cardiology/American Heart Association* guidelines for the prehospital management of STEMI patients support the implementation of specific destination protocols for select patients.[44,45] In particular, patients at high risk of death, those in cardiogenic shock, and those with contraindications to fibrinolysis should be transported primarily (or secondarily transferred) to facilities capable of cardiac catheterization and rapid revascularization. Evidence also suggests that when STEMI patients can be transported promptly to facilities with a moderate-to-high volume of interventional cases, percutaneous coronary intervention (PCI) is preferred over fibrinolysis for all STEMI patients, thus strengthening the case for direct transport to applicable facilities that meet these criteria.[46,47]

As this part of the proposed model is intended for implementation in large suburban and urban EMS systems, the following assumptions are made: First, at least one moderate-to-high-volume interventional cardiac facility (at least 225 acute interventions/year) is available to the community.[24,48–51] Second, patients can be transported to such a facility in a reasonable period of time (less than 60 minutes from initial dispatch to arrival at the hospital).

Given these assumptions, the proposed expanded model (Table 1) for performance for urban and large suburban EMS systems includes implementation and individual case documentation of the following key treatment elements for *patients with signs and symptoms consistent with ischemia with either ST elevation of at least 1 mm in 2 contiguous leads or left bundle branch block not known to have been present previously*:

1. Administration of aspirin (not enteric-coated), unless a contraindication or a recent previous ingestion is documented
2. Acquisition of a 12-lead electrograph (ECG) with appropriate, training-based interpretation by a paramedic and/or transmission to a designated emergency physician for interpretation
3. Direct transport to an identified appropriate interventional (PCI) facility for STEMI patients with a written plan to activate the cardiac catheterization team prior to EMS arrival
4. Elapsed time from acquisition of the diagnostic ECG (STEMI identified) to balloon inflation of less than 90 minutes

TABLE 1. Key Treatment Elements for Various Clinical Entities Encountered by EMS Systems

Clinical Area	Elements in Model
ST-Elevation Myocardial Infarction (STEMI).	Aspirin (ASA), if not allergic
	12-Lead electrocardiograph (ECG) with prearrival activation of interventional cardiology team as indicated
	Direct transport to percutaneous coronary intervention (PCI) capable facility for ECG to PCI time < 90 minutes
Pulmonary edema	Nitroglycerin (NTG) in absence of contraindications
	Noninvasive Positive Pressure Ventilation (NIPPV) preferred as first-line therapy over endotracheal intubation
Asthma	Administration of beta-agonist
Seizure	Blood glucose measurement
	Benzodiazepine for status epilepticus
Trauma	Limit non-entrapment time to < 10 minutes
	Direct transport to trauma center for those meeting criteria, particularly those over 65 (with time consistent caveats for air medical transport situations)
Cardiac arrest	Response interval < 5 minutes for basic CPR and automated external defibrillators (AEDs)

In an effort to quantify the magnitude of benefit for STEMI patients who receive all elements of this treatment bundle, results from the DANAMI-II and PRAGUE-II trials were utilized to determine a number-needed-to-treat (NNT).[46,47] While these trials include intravenous (IV) heparin and IV aspirin (Aspegic) and thus do not identically reflect the prehospital situation for many EMS systems in the United States, the similarities have been judged to be sufficient to make an estimate of benefit. In both of these studies, there was an absolute reduction of 6% in the composite endpoint of diminishing stroke, second nonfatal myocardial infarction (MI), or death. This calculation would result in a NNT of 15 to avoid stroke, a second MI, or death for just one patient (Table 2).

Again, data demonstrating the benefit for individual interventions are lacking. A recent meta-analysis

TABLE 2. Numbers-Needed-to-Treat (NNT) by Clinical Scenario

Clinical Area	Elements	NNT	Harm Avoided
ST-Segment Elevation Myocardial Infaraction (STEMI)	Aspirin 12-lead electrocardiograph (ECG), direct transport to percutaneous cardiac intervention (PCI) interval from ECG to balloon < 90 minutes[46,47]	15	Either a stroke, 2nd myocardial infarction, or a death
Seizure	Administration of benzodiazepine for status epilepticus[66]	4	Persistent seizure activity
Pulmonary edema	Noninvasive positive pressure ventilation (NIPPV)[59]	6	Need for an endotracheal intubation
Trauma	Patients with an Injury Severity Score (ISS) > 15 to trauma center[72]	11	1 death
Trauma	Patients over 65 years of age with ISS > 21 to trauma center[69]	3	1 death
Cardiac arrest	Defibrillator to the scene < 5 minutes rather than < 8 minutes[15]	8	1 death

failed to demonstrate definitive evidence of a mortality benefit for the prehospital 12-lead, although it was acknowledged that the five studies included in the analysis were not sufficiently powered to evaluate for such a benefit.[52] Given the magnitude of benefit demonstrated in DANAMI-II and PRAGUE-II, as well as recent publications documenting the importance of rapid reperfusion and the role of EMS in a reperfusion strategy, use of the EMS ECG to assist with hospital destination decisions and to activate the interventional cardiology team prior to arrival is still strongly endorsed.[46,47,53–56] Accordingly, it is essential that the prehospital 12-lead ECG analysis not only be performed, but that the results be utilized to activate the interventional cardiac treatment team prior to EMS arrival as well as to direct patients to capable PCI centers rather than the nearest hospital.[57,58] At the same time, in those areas that do not yet have the ability to direct patients to a PCI Center in a timely manner, the prehospital ECG still can be utilized to provide thrombolytic therapy sooner in appropriate cases.[52] Finally, it is recognized that the actual door-to-balloon time is not entirely in the control of EMS; the actions of EMS, however, have direct impact upon this time-critical clinical intervention. The performance measure includes the interval from ECG acquisition to balloon inflation, rather than a surrogate measure, because this is the interval that has been demonstrated to have the greatest impact on patient outcome. Also, in part, it is the EMS system's obligation to establish and monitor compliance with transport policies.

Respiratory Distress Performance Measures

Flash Pulmonary Edema/Congestive Heart Failure (CHF)

The Ontario Prehospital Advanced Life Support (OPALS) investigators noted that addition of paramedic level intervention in the treatment of severe respiratory distress reduced mortality by 2%, and that the majority of this benefit was conferred upon patients with pulmonary edema/CHF.[42] As with many prehospital studies, the incremental benefit of the individual ALS interventions was not established, but rather the complete bundle of treatment was evaluated and found to be life-saving. More recently, studies have suggested that there is a reduction in the proportion of pulmonary edema patients requiring endotracheal intubation (ETI) with the use of noninvasive positive pressure ventilation (NIPPV).[59–61] Importantly, although nearly 25% of patients in one study were ultimately found to have a cause of their respiratory distress other than pulmonary edema, the outcomes of this subset of patients still were not adversely affected by the provision of NIPPV.[59]

Given these assumptions, the proposed model for performance for urban and large suburban EMS systems includes implementation and individual case documentation of the following key treatment elements for *patients with respiratory distress assessed and presumed to be due to pulmonary edema/left-sided congestive heart failure (CHF):*

1. Administration of nitroglycerin (NTG) to patients without contraindications (e.g., a given lower limit of systolic blood pressure, recent sildenafil citrate use)
2. Prehospital provision of NIPPV to avoid ETI (both prehospital and in-hospital)

In prehospital- as well as hospital-based studies, the absolute reduction in the need for ETI by the utilization of NIPPV has been measured at 16–20%, yielding an NNT of 6.[59–61] However, based on the available evidence, the consensus opinion during the applicable discussion was that, in EMS systems with very short transport times (e.g., 10–15 minutes), the absolute value of the prehospital role of NIPPV remained unproven and should be considered, but not mandated, under such circumstances.

Bronchospasm

The provision of beta-agonists to patients with bronchospasm remains the mainstay of therapy, and this treatment may even be performed by EMT-basics.[62,63] Preliminary evidence now suggests a decreased odds of admission for the moderate-to-severe asthmatic patient who receives very early prehospital (vs. in-hospital) corticosteroid administration.[64] After extensive discussion, however, the group concluded the evidence for prehospital steroids to be of insufficient strength to include this treatment in the model. Therefore, the critical therapy of choice, by either EMT-basics or paramedics, remains the beta-agonist intervention.

Given these assumptions, the proposed model for performance for urban and large suburban EMS systems includes implementation and individual case documentation of the following key treatment element for *patients with respiratory distress found to have prolonged expiratory phase breathing/indicative of wheezing or known history of asthma/reactive airways disease:*

1. Provision of beta-agonist by the earliest-arriving, trained, and qualified personnel

The evidence for beta-agonist treatment of bronchospasm is not sufficiently robust to estimate a NNT, but it clearly is an intervention that can provide immediate relief of discomfort to the patient and also provide objective, measurable improvement in pulmonary status with early use.[65]

Status Epilepticus Performance Measures

In addition to general supportive interventions, the primary goal in the treatment of ongoing or recurring seizures is the cessation of convulsive activity. While most seizures stop spontaneously prior to EMS arrival on-scene, up to one-third of seizure patients will either have convulsive activity that continues until EMS arrival or have recurrent seizures in the presence of EMS.[66] A recent controlled, clinical trial demonstrated that IV benzodiazepines administration (compared with placebo) will not only diminish convulsive recurrences and ongoing seizures, but that they do so without incurring significant complications.[66] This elegant study deserves much credit, not only because it provides evidence-based confirmation of the efficacy for these specific anticonvulsives, but because it also examined the risk: benefit of such intervention. While benzodiazepine-induced respiratory failure is a known complication, the study itself showed that those risks are generally negligible with basic airway and ventilatory procedures, which should be considered part of this intervention.

Accordingly, given these assumptions, the proposed model for a performance measurement for urban and large suburban EMS systems includes implementation and individual case documentation of the following key treatment elements for *patients with seizure activity that persists for more than 15 consecutive minutes or has two or more seizures without an intervening period of clear mental status:*

1. Obtain and measure a blood glucose level
2. Administer a benzodiazepine (lorazepam or diazepam) by the best available route (IV, intramuscular [IM], rectal, or intranasal)

Intervention with appropriate benzodiazepines by EMS personnel will terminate 42–59% of these episodes, compared with only 21% resolution with placebo.[66] The former success rate is associated with diazepam and the latter with lorazepam, yielding NNTs of 5 and 3, respectively. Given this range, an estimated NNT of 4 to terminate a seizure that would not have otherwise terminated is utilized in the model.

Trauma

Rapid evacuation of severely injured patients to a trauma center has been associated with improved outcomes.[67–72] There is conflicting evidence, however, regarding the risk-benefit ratio of prehospital ALS interventions in trauma patients, particularly in the area of airway management.[73–76] Based on evidence available to date, it appears that rapid evacuation of trauma victims should have greater priority than advanced prehospital interventions.[77,78] While rapid evacuation, for example, may not be precluded by performance of ETI enroute, placement of the tube should not delay transport. In addition, before it is advocated, the other caveats about appropriateness of prehospital ETI need to be considered, including the ETI skills experience of the providers and their control of delivered positive pressure ventilations.[79,80]

Accordingly, the proposed model for a performance measurement for urban and large suburban EMS systems includes implementation and individual case documentation of the following key treatment elements for *patients meeting American College of Surgeons trauma center triage criteria:*

1. In general, transporting paramedics (or transporting basic EMTs) should limit on-scene time to less than 10 minutes or document reasons for the exception (e.g., entrapment, scene safety, etc.).
2. Transport should be provided immediately and directly to designated trauma center.
3. If on-scene time is extended while awaiting air medical rescue crews to arrive, the total presumed ground and transport time intervals for the air crews should not exceed that of the time that

would have been required by ground crews to get the patient to the trauma center.

It is recognized that the Injury Severity Score (ISS) is a retrospective measurement and thus is not determined in the prehospital setting. The available evidence that allows an estimate of the NNT incorporates age and ISS, however, and thus ISS is included in the model, requiring cooperative data exchange with the trauma center. For patients with an ISS of 15 or greater, the number needed to treat (i.e., direct transport to a trauma center) is 11 for all age groups and 3 for patients over the age of 65.[69,72]

Other Performance Measures

Clearly, there are other performance measures that could be used by EMS systems, including compliance with nontransport criteria, qualitative or quantitative measurement of end-tidal carbon dioxide after airway placement, application of cervical collars and spinal immobilization, administration of supplemental oxygen to patients with presumed strokes, respiratory distress or coronary artery syndromes, provision of pain relief, IV or intraosseous access for patients with unstable vital signs or cardiac rhythms, rapid termination of atrial tachycardias with adenosine, treatment of anaphylaxis with epinephrine, or myriad of other emergency therapies and management protocols. While these actions are all well-accepted treatments and procedures and, while they are excellent targets for internal quality assurance audits and performance measurements, they are not all fully substantiated by scientific literature, are controversial in some situations, or are infrequent in occurrence, and thus not necessarily appropriate to use for benchmarking EMS systems. Nonetheless, it is hoped that such additional measures can be studied further and subsequently utilized as performance criteria for intersystem comparisons.

CONCLUSIONS

This document proposes a multifactorial model of EMS system performance measurement for large urban and suburban EMS Systems, based on the currently available scientific evidence. Beyond the traditional benchmarking focus on cardiac arrest survival rates and response-time interval performance, an expanded evidence-based model, including documentation of care for ST-segment elevation MI, pulmonary edema, bronchospasm, seizure, and trauma patients, is presented. This approach not only allows local EMS leaders to more accurately report a broader picture of the performance of their system in a method that can be understood by all stakeholders, but it also may be utilized in a benchmarking fashion so that best practices in urban and suburban EMS systems may be quantified and reproduced. Based on sound, large-scale scientific studies, the number of lives saved by a particular EMS system can be extrapolated for these particular measures with some relative confidence. For example, based on existing literature, if an EMS system has encountered 90 patients with STEMI and appropriately completed the appropriate treatment bundle in 60 cases, then one could presume and report that a second heart attack, stroke, or death had been likely avoided for four patients. In the same way, it also could be presumed and reported that if the EMS system had been functioning optimally, six patients would have realized this same benefit. Once the element (or those elements) of the treatment bundle are identified that are preventing 100% compliance, focused efforts for performance improvement can be justified by a quantifiable metric.

There are limitations to this type of model, including a lack of a sufficient number of high-quality trials for many other infrequently occurring conditions. It is anticipated that the Consortium that developed these new benchmarks and other professional organizations will still attempt to update this model as more evidence does become available. For the time being, it is hoped these guidelines will serve as a new prototype and a starting point for future performance measurements and benchmarking in appropriately-sized EMS systems.

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APPENDIX

Participants from the U.S. Metropolitan Municipalities' EMS Medical Directors' Consensus Panel on Evidence-Based Performance Measures, February 15–18, 2007, Dallas, Texas

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