EMS MEDICAL DIRECTORS ASSOCIATION OF CALIFORNIA

POSITION PAPER

EMS RESPONSE INTERVALS

September 22, 1998

INTRODUCTION:

The 1993 California EMS Systems Standards and Guidelines established response time standards and recommended guidelines, "to guide local EMS agencies in the planning, organization, and evaluation of local EMS systems."(1) These standards and guidelines were developed through a consensus process. They were not based on existing medical evidence and event definitions were not precise. It has been five years since their publication, and new technology, training curricula, and outcome-based clinical information are now available. EMDAC believes that this information should be considered by the EMS community. This position paper is intended to establish definitions for response-associated events and to aid in the revision of the original guidelines to meet a more appropriate and current standard.

BACKGROUND:

The 1993 California EMS System Standards and Guidelines set forth the following "Minimum Standard" for EMS systems:

"Each local EMS agency shall develop response time standards for medical responses. These standards shall take into account the total time from receipt of the call at the primary public safety answering point (PSAP) to arrival of the responding unit at the scene, including all dispatch intervals and driving time."

In addition, the following "Recommended Guidelines" were established for Metropolitan and Urban areas:

"...for ninety percent of emergent responses the response time does not exceed:"

BLS/CPR/defibrillation:	5 minutes
ALS (not first responder):	8 minutes
EMS transportation unit:	8 minutes

POSITION:

The Emergency Medical Services Medical Director's Association of California (EMDAC) recommends the following definitions, standards, and guidelines be adopted. These recommendations are based upon a review of the available scientific literature and the expert consensus of EMDAC:

1. The following definitions should be used in the reporting of response-associated events:
   a. "Receipt of Call": The time of the first telephone ring at the primary PSAP.

b. "On-Scene time": The time the vehicle arrives at the scene and its wheels stop.
c. "Call-response interval": Starts at the "Receipt of Call" and ends at the "On-Scene Time."

2. All time-recording devices should be synchronized to Coordinated Universal Time (UTC) and times should be measured in seconds and not rounded up or down to the nearest minute.

3. Ninety percent fractile response intervals should be used in all performance reports.

4. EMS systems should establish information systems capable of accurately monitoring and linking response-associated events for all system participants.

5. The following response intervals should be recommended guidelines:

In Metropolitan and Urban areas, for presumptively defined life-threatening emergencies, ninety percent of call-response intervals, measured from the receipt of call at the primary PSAP, do not exceed the following:

a. Responders capable of performing Basic Life Support and Defibrillation	5 minutes, 0 seconds
b. Responders capable of performing Advanced Life Support	10 minutes, 0 seconds
c. Patient transportation capable vehicle	12 minutes, 0 seconds

DISCUSSION:

In a widely cited study published in JAMA in 1979, Eisenberg et al reported maximal survival (43%) in those patients with witnessed cardiac arrests due to primary heart disease who had CPR within 4 minutes of the time of collapse and "definitive care" within 8 minutes.(2) Two fundamental errors appear consistently in the subsequent interpretation of this report. First, the time intervals in this report started at the point of collapse and ended at the performance of a procedure on the patient, whereas subsequent "response time standards" have started at the time responding units are notified and end when the unit is at the curb. Without adding in the pre-activation, dispatch, and on-scene-to-patient-contact intervals the "response times" frequently used today dramatically underreport the full collapse-to-intervention interval as measured by Eisenberg.

Second, in the Eisenberg study EMTs performed CPR and paramedics were able to provide "definitive care", which was defibrillation, intubation, and IV medications. With the subsequent introduction of automated defibrillators, this component of Eisenberg's "definitive care" is now performed by EMTs (and even laypersons). The time to defibrillation rather than the time to ALS now more closely matches Eisenberg's "time to definitive care." The American Heart Association ACLS guidelines fail to distinguish between defibrillation and other ALS interventions when citing this report in proposing 4 minute CPR and 8 minute "ACLS" as optimal.(3)

EMS response time guidelines and standards throughout the country have been largely based on misinterpretations of the time intervals and scope of practice of EMS personnel in Eisenberg's study. In addition, the lack of standardization of other definitions, time recording, and time interval reporting further contributes to the wide variation seen in the subsequent development of EMS response interval standards.

These recommended standards refer to the clinical function of the responders and not to the specific participating agencies. The EMS Systems Standards and Guidelines specified that the ALS responder requirement could not be met by the first responder. There is no clinical justification for this distinction. The time of arrival of an ALS-capable responder can be met by first-responder or transport ambulance personnel, and the requirement for BLS and defibrillator-capable responder can be met by ALS-capable responders. In addition, in many systems, transport ambulance personnel arrive prior to first responders a significant percentage of the time, and this should be considered in the overall response interval reports.

The response interval recommendations are meant to apply to metropolitan and urban areas as defined in the EMS System Standards and Guidelines. Rural systems must weigh response interval recommendations against capability allowed by their local resources.

The Utstein Style (4) proposed definitions for "on-scene time", and "call-response interval" should be adopted. However, neither the Utstein group nor the EMS Systems Standards and Guidelines define "receipt of call at the primary PSAP". At least four different definitions are in use: a) Time of first ring at the 9-1-1 console, b) Time of pickup of the call, c) Time the interview of the reporting party by the EMS dispatcher starts, and d) Time of entry of the call into the computer aided dispatch (CAD). Time of first ring at the 9-1-1 console most accurately measures the time the emergency response system is first notified and therefore should be used.

Without system-wide time synchronization and recording of times in minutes and seconds, it is impossible to accurately evaluate the multiple processes that occur during an EMS response. Time-recording devices commonly differ by 5-10 minutes from the universal standard time - Coordinated Universal Time (UTC) - and can differ by as much as hours.(5-7) UTC synchronization devices are not routinely installed in 9-1-1 controllers or CADs. UTC time is readily available from several sources, including radio broadcast (WWV, WWVB) and GPS satellites, and these are easily interfaced with the 9-1-1 controllers and CADs. Commonly available sources, such as the Weather Channel, broadcast UTC time and can be used to synchronize watches and other non-interfaced timepieces.

The EMS Systems Standards and Guidelines established the 90% fractile response interval as the means with which to measure performance. Once a clinically relevant time interval standard is validated, resources must be deployed to comply with this standard with as great a reliability as possible. Other measurement methods, such as "average", "mean", or "median" response times allow for 50% or more of the responses to exceed the clinical standard, whereas the 90% fractile method allows a maximum of 10% of responses to be delayed. In a normally distributed response-time curve, a 5 minute "average" response time would be equivalent to a nearly 10 minute 90% fractile response time.

Comprehensive information systems are essential to adequately monitor an EMS system. The response interval standards considered here are only one component of the system's overall clinical performance. In the case of cardiac arrest for example, the most clinically useful time interval is from collapse to defibrillation, which has been shown to be a more accurate predictor of survival than BLS or ALS response intervals.(8) Monitoring should include all time intervals from the onset of the emergency medical problem (e.g., cardiac arrest, traffic collision, chest pain) to the performance of the critical medical interventions on-scene. Additional required documentation includes scene time, transportation, and time to definitive care in the hospital. At this time few EMS systems have the capability to obtain the time data points necessary for this global analysis, and none can accurately measure the pre-activation interval with any reliability.

The use of warning lights and siren can reduce response times (9), but is not without risk to patients, motorists, and EMS personnel.(10,11) Dispatch policies should balance the potential clinical benefit against the risks of lights and siren response. Structured caller interrogation and prioritized dispatch have been shown to be accurate and effective.(12) In addition, increasing availability of responding units can reduce response intervals to life-threatening emergencies. Dispatcher instructions provide immediate medical assistance to certain emergencies (e.g. choking, bleeding, childbirth, CPR) and can be life saving.(13)

Local EMS systems vary considerably in the structure of their dispatch systems. Numerous primary PSAPs, secondary PSAPs, and ambulance dispatch centers participate. Each local EMS system must develop specific call-processing time standards for the individual dispatch centers. Minimizing the time interval between the receipt of call at the primary PSAP and dispatch of the responding vehicles increases the likelihood of meeting the recommended response interval standards.

A response-time dependent outcome benefit for CPR and defibrillation has been clearly demonstrated for ventricular fibrillation cardiac arrest.(14-19). Valenzuela et al reported survival rates of patients with witnessed ventricular fibrillation cardiac arrests as a function of time to CPR and time to defibrillation.(15) Their results are summarized below:

		Collapse to defibrillation (min.)	
		<=10	>10
Collapse to CPR (min.)	<=5	37%	7%
	>5	20%	0%

It is impractical to expect the EMS responders to reliably perform CPR within 5 minutes of collapse in most systems. Citizen CPR training and dispatcher-directed CPR has been shown to be practical and effective, and should be emphasized in all EMS systems. Defibrillation within 10 minutes of collapse is an achievable goal in urban systems. Allowing for a two minute interval from collapse to 9-1-1 activation, the time from receipt of call to defibrillation should not exceed eight minutes. A five minute response interval will allow three minutes to locate and assess the patient, apply the defibrillator, allow the device to detect ventricular fibrillation and deliver the shock. The 90% fractile vehicle-at-scene to defibrillation interval has been reported to be a minimum of 3-6 minutes, and much longer in dense urban areas such as New York and Chicago (8,20-23).

The first report of EMT manual defibrillation appeared in 1980 (24) and EMT automated defibrillation in 1987.(25) Prior to this, including in the Eisenberg study, the EMT scope of practice for cardiac arrest was limited to CPR and mask ventilation. Paramedics were trained to perform manual defibrillation, tracheal intubation, and administer IV medications. Studies published after the introduction of EMT-defibrillation in 1987 have confirmed the value of CPR and defibrillation, but have not substantiated the role of other ACLS measures.(26-31) This confusion in the definition of "ALS" has contributed to the ongoing misconception that "8 minute ACLS" is of demonstrated value. Automated defibrillation is one example of the blurring of the distinction between "BLS" and "ALS". It has been suggested that these terms are outdated and that we should abandon them entirely.(32) This is an appropriate goal. Because of their imprecise definitions, it is important to understand the exact scope of practice and medical oversight of "BLS" or "ALS" field personnel to interpret published EMS reports.

The evidence supporting a response time standard for advanced life support capable personnel is less clear than that for CPR and defibrillation. There is no supporting medical evidence for the existing eight minute recommended guideline. In a report of cardiac arrests of rhythms other than ventricular fibrillation, ALS care may have been beneficial, although a response-time correlation was not shown.(33) In a report of cases of cardiac arrest of non-cardiac etiology, the time to arrival of first responders was the only treatment-related factor that correlated with survival.(34) Out-of-hospital emergencies other than cardiac arrest that would logically benefit from prompt medical treatment also occur. Examples are upper airway obstruction, acute asthma, pulmonary edema, and anaphylaxis. ALS field treatment has been shown to be beneficial (35,36), but no published study has demonstrated a response-time related outcome effect in these conditions.

The exact role of ALS measures in the management of trauma is not yet established. There is some evidence that ALS care can result in improved outcome in the treatment of the trauma patient.(37-42) In head-injured patients, endotracheal intubation may improve survival. (43) Others have concluded that intravenous fluids are not helpful.(44-47) There have been no reports that conclude that there is a response-time dependent effect on patient survival, although the total time from injury to definitive care is an important variable in patient outcome.(48-52) These studies underscore the importance of prompt response of the transportation vehicle and rapid evaluation, treatment, and transportation of the severely injured patient.

The transport-capable vehicle standard recognizes the need for rapid transportation of conditions requiring urgent in-hospital care, such as major trauma, acute MI, ruptured ectopic pregnancy, and GI hemorrhage. Prompt transportation is also important when field assessment may be difficult (such as in acute respiratory distress), or when personnel are unsuccessful in their attempt to perform field procedures (e.g., IV access, ET intubation).

SUMMARY:

EMS system response interval standards have been largely based on misinterpretations of a 1979 report on survival after cardiac arrest. Non-standardized definitions and inaccurate time measurements have further confused the issue. The 1993 EMS System Standards and Guidelines were developed by a consensus process and were not evidence based. All times should be recorded by UTC-synchronized timepieces, recorded in minutes and seconds, and reported in 90% fractile intervals. Comprehensive information systems must to be developed and are essential for the adequate monitoring of EMS systems. Current best medical evidence suggests that response intervals for presumptively defined life-threatening emergencies, measured from the time of first ring at the primary PSAP until arrival at the scene with wheels stopped, should be 5 minutes for responders capable of performing CPR and defibrillation, 10 minutes for providers capable of performing ALS, and 12 minutes for a transport-capable vehicle.

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