AHA Medical/Scientific Statement

Special Report

Recommended Guidelines for Uniform Reporting of Data From Out-of-Hospital Cardiac Arrest: The Utstein Style

A Statement for Health Professionals From a Task Force of the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, and the Australian Resuscitation Council

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Resuscitation has become an important multidisciplinary branch of medicine, demanding a spectrum of skills and attracting a plethora of specialties and organizations, each of which claims a legitimate interest in the science and practice of resuscitation. This complex background has hindered the development of a uniform pattern or set of definitions for reporting results. Different systems cannot readily be compared or contrasted because data are rarely compatible. Representatives from the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, and the Australian Resuscitation Council recently met to establish uniform terms and definitions for out-of-hospital resuscitation.

The American Heart Association has supported resuscitation activities since 1977. The European Resuscitation Council was formed in August 1989 as a multidisciplinary group of representatives from the European Society of Cardiology, the European Academy of Anesthesiology, the European Society for Intensive Care Medicine, and related national societies. In June 1990 members of these organizations attended an international resuscitation meeting at the historic Utstein Abbey, located on a small island near Stavanger, Norway. Participants discussed the widespread problem of nomenclature and the lack of standardized language in reports. A second meeting, with participants from Canada and Australia, was held in December 1990, in Surrey, England. The delegates voted unanimously to call the second meeting the Utstein Consensus Conference. The task force offers these new recommendations as a starting point for more effective exchange of information and to improve international audit. It is hoped that these recommendations will carry the name of the ancient abbey; the "Utstein Style" may be a suitable designation.

Uniform reporting of data from in-hospital cardiac arrest will be the subject of a future conference and publication. This report focuses on out-of-hospital cardiac arrest and includes a glossary of terms, a template for reporting data from resuscitation studies to ensure comparability, definitions for time points and time intervals related to cardiac resuscitation, definitions of individual clinical items and outcomes that should be included in reports, and recommendations for the description of emergency medical resuscitation systems.

Glossary of Terms

The nomenclature of cardiac arrest presents a classic problem in semantics—the same term has

"Recommended Guidelines for Uniform Reporting of Data From Out-of-Hospital Cardiac Arrest: The Utstein Style" was approved by the American Heart Association SAC/Steering Committee on February 13, 1991 and the European Resuscitation Council in January 1991. It has also been approved by the Heart and Stroke Foundation of Canada and the Australian Resuscitation Council.

This report is also being published in the August 1991 issue of *Annals of Emergency Medicine* and the September 1991 issue of *Resuscitation*, as well as German translations for *Notfallmedizin* and *Intensivmedizin und Notfallmedizin*.

Requests for reprints should be sent to the Office of Scientific Affairs, American Heart Association, 7320 Greenville Avenue, Dallas, TX 75231.

different meanings to different people. The Utstein recommendations are an attempt to solve this problem by presenting consensus definitions. Previous publications provided a useful starting point.[1-10] The Utstein recommendations focus on poorly defined areas of clinical epidemiology and data that emergency personnel and clinicians should acquire as a tool to improve both knowledge and treatment.

The definitions may deviate in nuance from traditional and textbook terminology since practical usage in different settings produces an evolutionary drift in meaning. During discussions at the consensus conference, task force members repeatedly emphasized the need to remove ambiguity, provide specificity, and promote valid comparisons.

Cardiac arrest. Cardiac arrest is the cessation of cardiac mechanical activity, confirmed by the absence of a detectable pulse, unresponsiveness, and apnea (or agonal, gasping respirations).[3,6,11] For the purposes of the Utstein style, no comment on time or "suddenness" is recommended.[3]

Bystander CPR, lay responder CPR, or citizen CPR. While these terms are synonymous, the consensus conference participants prefer *bystander CPR*, which is an attempt to perform basic cardiopulmonary resuscitation (CPR) by someone who is *not* part of an organized emergency response system. In general, this will be the person who witnessed the arrest. Thus, in certain situations, physicians, nurses, and paramedics may perform *bystander*, or more appropriately, *professional first responder CPR*.

Emergency personnel. Persons who respond to a medical emergency in an official capacity as part of an organized response team are called *emergency personnel*. By this definition, physicians, nurses, or paramedics who witness a cardiac arrest in a public setting and initiate CPR but do *not* respond as part of an organized team are *not* emergency personnel.

Cardiopulmonary resuscitation. CPR is a broad term meaning an *attempt* to restore spontaneous circulation. CPR can be classified as successful or unsuccessful and basic or advanced (see below).

Basic CPR. Basic CPR is the attempt to restore effective circulation with external compressions of the chest wall, plus expired air inflation of the lungs. Rescuers can provide ventilation through airway adjuncts and face shields appropriate for use by the lay public. This definition excludes the bag-valve-mask, invasive techniques of airway maintenance such as intubation of the airway, and airway devices that pass the pharynx.

Basic cardiac life support. In the United States especially, this term has an expanded meaning beyond *basic CPR*. It describes an educational program that provides information about access to the emergency medical services (EMS) system and recognition of cardiac arrest as well as basic CPR.[12]

Advanced CPR or advanced cardiac life support (ACLS).[13,14] These terms refer to attempts to restore spontaneous circulation with basic CPR plus advanced airway management and ventilation techniques, defibrillation, and intravenous or endotracheal medications. There are several possible intermediate levels of care defined by the number and types of interventions provided. Rather than provide specific titles for this entire list of possibilities, consensus conference participants have recommended specific descriptions of interventions that are permitted (see "Description of EMS Systems").

Cardiac etiology (presumed). Cardiac arrest presumed to be related to heart disease is a major focus of most prehospital EMS systems. It is impractical for researchers to accurately determine the specific cause of cardiac arrest for all attempted resuscitations. Growing acceptance of the biological model of sudden cardiac death places little value in attempts to discriminate between thrombotic and electrophysiological cardiac arrest.[15,16] In this model, many functional factors may interact with a host of underlying structural abnormalities to initiate lethal arrhythmias.

For the purposes of the Utstein Style Template, researchers should classify cardiac arrests as presumed cardiac etiology if this is likely, based on available information. In the best of circumstances, this can include autopsy data and hospital records. However, this frequently becomes a diagnosis of exclusion. Patients who do not fit in the more readily defined category *cardiac arrest of noncardiac etiology* are included in this category.

Noncardiac etiology. Noncardiac causes of cardiac arrest are often obvious and easy to determine. Specific subcategories include sudden infant death syndrome, drug overdose, suicide, drowning, hypoxia, exsanguination, cerebrovascular accident, subarachnoid hemorrhage, and trauma.

Call-response interval. This term replaces *response time*, one of the most frequently, yet inconsistently, used terms in resuscitation. The *call-response interval* is the period from receipt of call by the emergency response dispatchers to the moment the emergency response vehicle stops moving (Figures 1 and 2). Note that this interval does *not* begin when the emergency response vehicle begins to move. The call-response interval includes the time required to process the call, dispatch emergency personnel, move personnel from their quarters to the emergency vehicle, start the vehicle in motion, and travel to the scene. Note that this interval does not extend to arrival at the patient's side nor to time of defibrillation. Recently published data show that the intervals from the time the vehicle stops to arrival at the patient's side and to delivery of first defibrillatory shock may be too long and may play a major role in determining survival.[17,18]

Automated external defibrillators. The generic term *automated external defibrillator* refers to a defibrillator that performs rhythm analysis of the patient's surface electrocardiogram. This rhythm analysis is dichotomous—either ventricular fibrillation/ventricular tachycardia or nonventricular fibrillation. The automated external defibrillator provides information to the operator when it detects

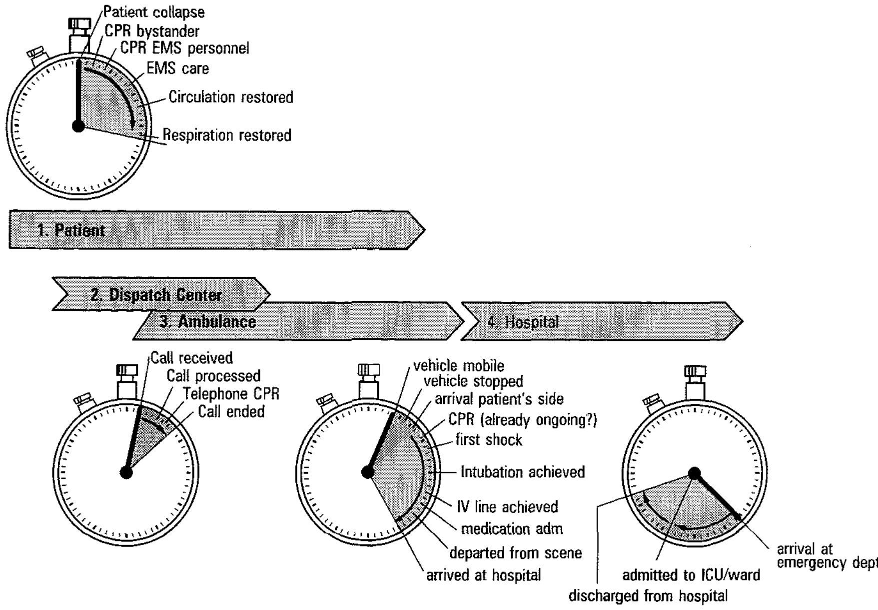


FIGURE 1. *The four clocks of sudden cardiac arrest.*

ventricular fibrillation or rapid ventricular tachycardia. This information is also dichotomous—either "shock" or "no shock indicated."

Times versus intervals. Imprecise and inconsistent use of the terms *time* and *interval* has produced much confusion and misunderstanding in literature about cardiac arrest. *Interval,* not *time,* refers to the period between two events. The definition of the interval should be clear from the expression used and should not be dependent on EMS jargon. The format for expression of intervals should be *event-to-event interval,* with an explicit statement of the two anchor events. For example, various authors have used *downtime* to refer to either the *collapse-to-start of CPR interval*, the *collapse-to-first defibrillatory shock interval*, or the *collapse-to-return of spontaneous circulation interval.* Numerous authors have also used *time-to-definitive care* to establish the importance of short intervals between collapse and intervention. In practice, however, this term has meant only the arrival at the scene of advanced life support personnel who can *deliver* definitive care. The true times of delivery (and related intervals) for the specific elements of *definitive care* (defibrillatory shocks, intubation, and vasoactive medications) remain unknown.

Template for Reporting Data From Cardiac Arrest

The Template Approach

The consensus conference participants recommend the template approach to reporting data—especially outcome data—relating to cardiac arrest (see Figures 3 and 4). Figure 3 is a graphic representation of data on cardiac arrest resuscitation that researchers should report. The denominator begins with cardiac arrest patients with cardiac etiology and displays how this group will progressively decrease to the proportion alive at 1 year.

Figure 4 presents the Utstein Style Template for collection of all cardiac arrest data. A specific number must be inserted for each level to permit researchers to calculate multiple rates. The number at each level serves two functions: the denominator for levels above and the numerator for levels below.

The template begins with the population served by the EMS system and displays various exit points before arrival at the cardiac etiology patients presented in Figure 3. Some items included in the template are defined in the Glossary of this report; others are discussed below. Use of this scheme by EMS systems will permit immediate comparisons with other systems that have used the template and have published or distributed their results.

Consensus conference participants could have selected different branch points at different levels with equal validity. For example, patients could have been classified as having ventricular fibrillation rhythms or nonventricular fibrillation rhythms at the point just below "resuscitations attempted" (Figure 4), providing a group of patients classified by rhythm alone. However, there would also have been a large group of patients in ventricular fibrillation of both cardiac and noncardiac etiologies. As presented in Figure 4, the template has the advantage of encouraging widespread standardization and uniformity.

Further divisions are not displayed below the shaded exit points to the left. Nevertheless, all downstream subsets remain possible. For example, researchers could analyze cardiac arrests of noncardiac etiology in detail, asking whether bystanders or emergency personnel witnessed the arrest and what the initial rhythms and various clinical outcomes were. The template does not display all possible outcomes, even though collection of the recommended individual clinical data would permit detailed analyses and presentations.

The Issue of Outcomes

Evaluators can calculate a large variety of outcomes from the reporting template since multiple combina-

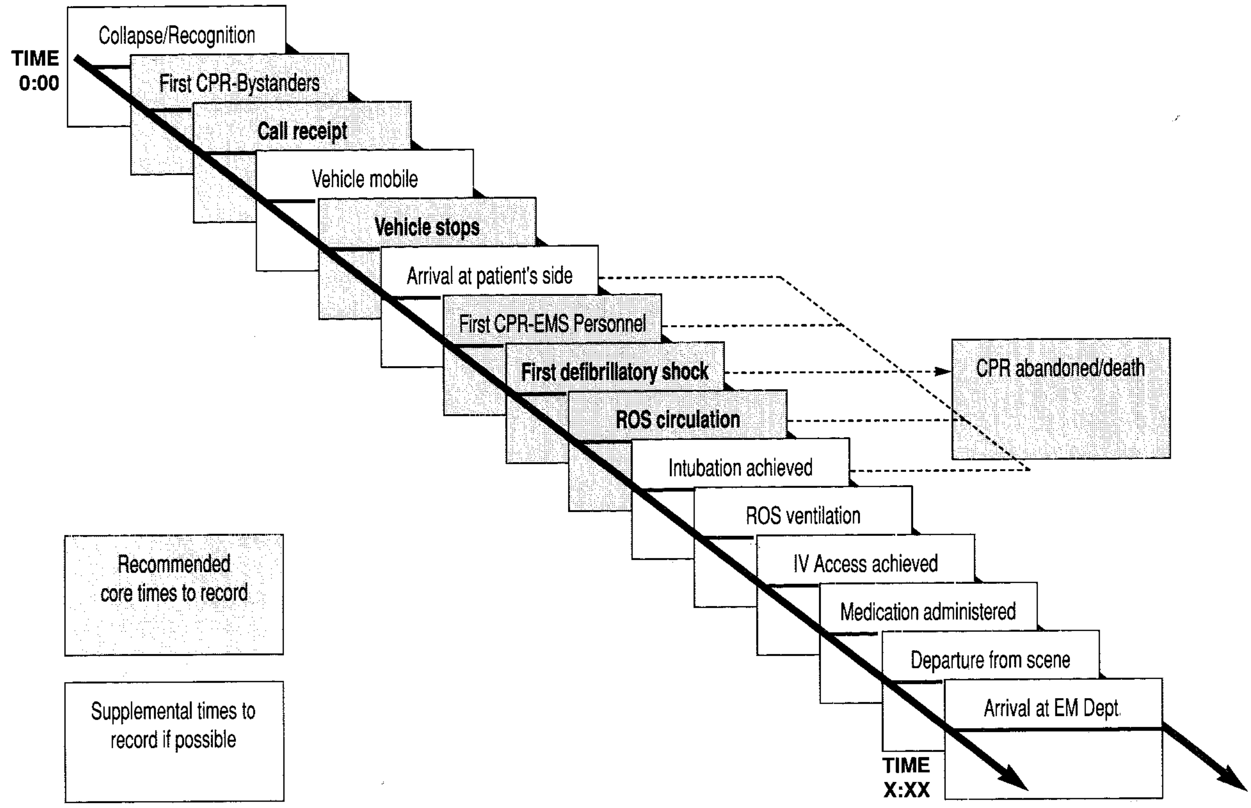
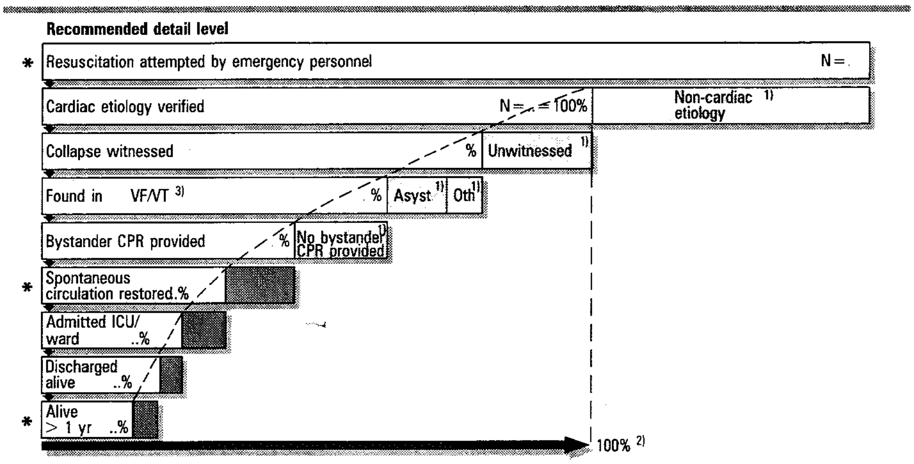


FIGURE 2. *Events associated with out-of-hospital cardiac arrest resuscitation attempts.*

tions of denominators and numerators are possible. Reported outcomes should be presented as rates or percentages, for example, the rate of successful admissions per total resuscitations attempted. The best outcome to report may differ among various systems and locations. Most authors recommend reporting the number discharged alive divided by the number of persons with witnessed cardiac arrest, in ventricular fibrillation, of cardiac etiology.[7,8,17,19] This single rate would be most practical for multiple intersystem comparisons and was recommended by the consensus conference participants. Although core information, this rate indicates only a small proportion of a system's total activities and thus fails to capture the complexity of EMS resuscitation activities.

The reporting template supports multiple comparisons and may help detect clinically interesting subsets of patients. For example, a new treatment may help a higher percentage of persons who are initially asystolic achieve return of spontaneous circulation in the field but may produce no improvement in overall survival. If only discharged alive rates are reported,



* Minimum data level
1) Subgroups with an additional survival potential which may be analyzed using an identical pattern, i.e broken into the lower steps in the template
2) For purposes of uniform reporting the recommended "100%", or denominator group, is resuscitations attempted on cardiac arrests of cardiac etiology
3) VT should be reported as a separate group

FIGURE 3. *Utstein II recommendations on data to be reported on cardiac arrest resuscitation.*

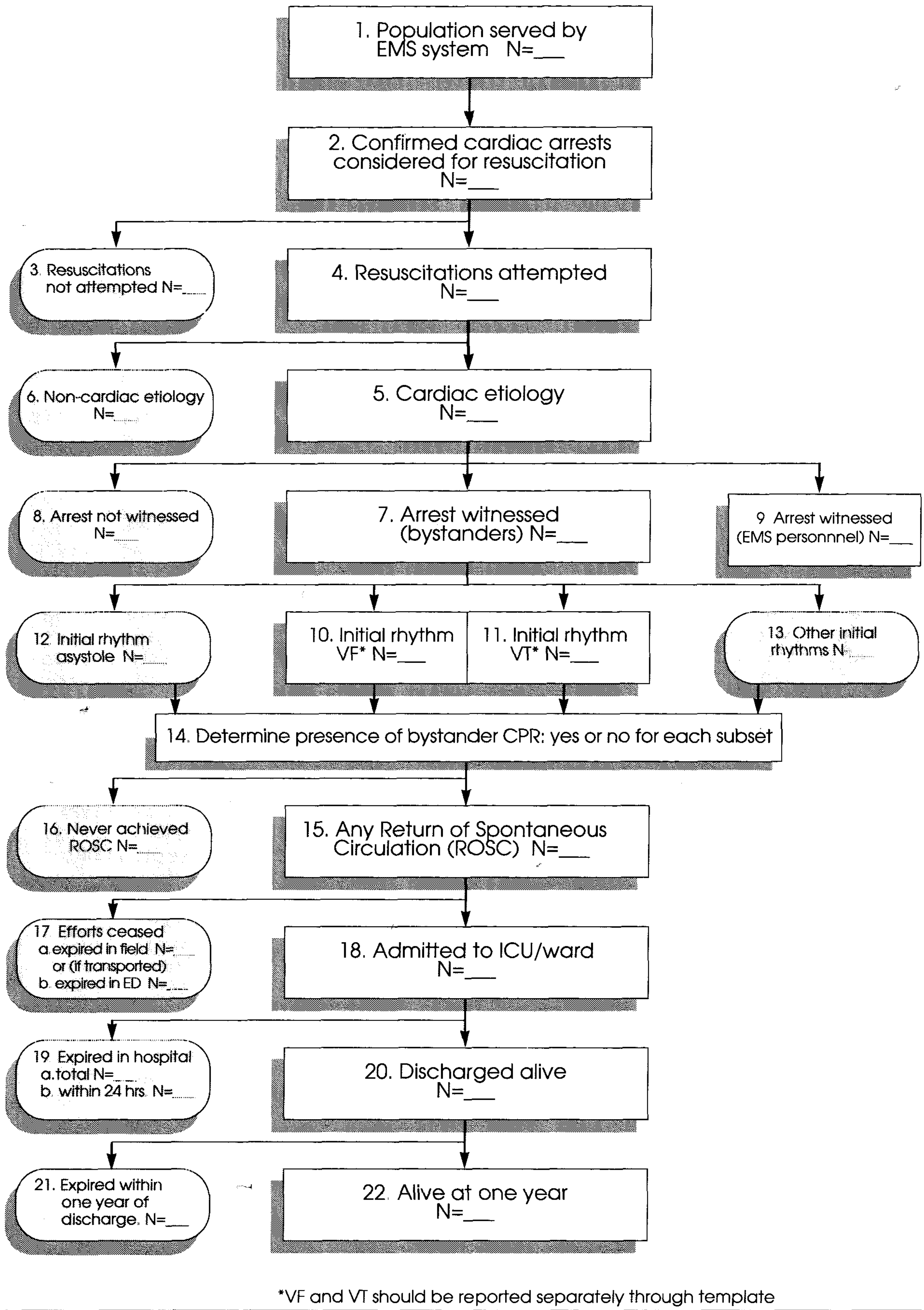


FIGURE 4. *Recommended Utstein Style Template for reporting data on cardiac arrest.*

this potentially important benefit will be overlooked.

The Utstein Style encourages the use of *core data* and *supplementary data*. *Core data* are data without which analyses and comparisons would be difficult or meaningless. These data are generally easier to collect, and in some systems are routinely collected. *Supplementary data* are more comprehensive and more specific and should be reported whenever possible. They permit more detailed comparisons and more precise analyses of outcomes. However, they are generally more difficult to collect and tend to be less precise than core data.

Template Sections

1. Population served. The template starting point is the population served, which permits calculation of population-based incidence as well as population-based survival rates. The total population of a community is a useful figure only when the entire population resides within the specific EMS system service area. The methodology section of any manuscript or report on cardiac arrest outcomes should include a description of the community served. Core data to include for out-of-hospital cardiac arrests are total population served by the EMS system, geographic area served (in square kilometers), and percentage of the population more than 65 years old.

Supplementary data should include special problems or unique circumstances within a community, for example, the presence of many high-rise residential buildings, multiple languages, unusual geography or climate, narrow roads, and unique traffic regulations or other conditions.[17] To provide an optimal picture of the community served by an EMS system, the Utstein Consensus Conference participants recommend reporting the following:

- Gender: percentages of men and women in the total population
- Educational level: average level of education or the percentage of persons who continue their education past the compulsory school level, or both
- Socioeconomic status: percentage of persons below the poverty level (the definition of this poverty level must be stated for each community)
- Age: mean age of the population provides little useful information. The percentage of the population in each of the following age groups should be stated: 0–12 months, 1–4 years, 5–14 years, 15–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, 65–74 years, 75–84 years, and more than 85 years.
- Total number of annual deaths in the community
- Percentage of deaths attributable to ischemic or coronary heart disease (International Classification of Diseases [ICD] Codes 410–414)
- Deaths per 100,000 population per year from all causes
- Annual deaths per 100,000 population from ICD codes 410–414 for men aged 55–64 and women aged 55–64
- Total number of persons in the EMS system community who have completed CPR training (American Heart Association or Red Cross) in the past year and over the past 5 years. This figure relates to another recommended item to report: the percentage of cardiac arrests in which bystanders initiated CPR.

2. Confirmed cardiac arrests considered for resuscitation. All unresponsive, breathless, and pulseless patients for whom the EMS system is activated are included in this section. Emergency personnel must confirm cardiac arrests. The number of patients who had resuscitations attempted (ventilation attempts, chest compressions, or both) by lay rescuers but were observed by emergency personnel to have a pulse upon arrival should be noted. This additional subgroup permits an assessment of possible lay person "saves," but may include false-positive cardiac arrests and respiratory arrests. This group should be tabulated separately and not included in the total of confirmed cardiac arrests considered for resuscitation.

3. Resuscitations not attempted. Resuscitation attempts for some patients in cardiac arrest are inappropriate and should not be initiated. The local criteria for such patients should be stated in reports of out-of-hospital cardiac arrests. Such criteria include obvious evidence of irreversible death, such as decapitation, incineration, decomposition, rigor mortis, or dependent cyanosis. This group also includes people with "do-not-resuscitate orders" or living wills, provided that no resuscitation efforts were made.

4. Resuscitations attempted. This group includes all persons whom emergency system personnel attempted to resuscitate (other than basic assessment). A *resuscitation attempt* refers to some effort at basic CPR. This definition mandates that this section of the template will include persons with do-not-resuscitate orders or living wills or those for whom senior attendants halted resuscitation efforts upon their arrival. With the goal of precision and standardization, consensus conference participants recognize that overall success rates will be slightly lowered by a denominator that includes those in whom there is no possibility of successful CPR.

5. Cardiac etiology (see Glossary). Emergency personnel should determine the presence and duration of antecedent signs and symptoms of ischemia. This permits discussion of the suddenness of the arrest and consideration of the mechanisms of arrest, such as primary electrical events in contrast to ischemic or thrombotic events. However, boundaries between these groups are often blurred, both clinically and physiologically, and are not required for reporting of cardiac arrest data.

6. Noncardiac etiology (see Glossary). The template shows noncardiac etiology as an exit event. However, consensus conference participants strongly recommend the acquisition of more detailed data about this group to permit recording and reporting of all features of the template listed below *cardiac etiology* (e.g., witnessed, rhythms, outcomes).

7. Arrest witnessed and 8. arrest not witnessed. The recommended focus of the Utstein Style Template is witnessed arrests, in which the patient's collapse was seen or heard by a bystander or emergency personnel or both. The Utstein Style Template displays unwitnessed arrests and arrests of noncardiac etiology as exit categories. However, supplementary recording and reporting includes rhythm identification, presence of bystander CPR, and clinical outcomes for unwitnessed arrests.

9. Arrests after arrival of emergency personnel. Most reports of cardiac arrest note that approximately 10% of out-of-hospital cardiac arrests occur after the arrival of emergency personnel.[17,19–21] The Utstein Style recommends that arrests after arrival be separated from unwitnessed arrests and bystander-witnessed arrests (Figure 4).

There are two reasons for this separation. First, the presence or absence of bystander CPR and the length of call-response intervals do not apply to these patients. Inclusion of these patients would distort tabulation of the percentage of patients who receive bystander CPR and measurement of the call-response interval. Second, the arrest-after-arrival subgroup provides important information that should be analyzed and reported separately. For example, some researchers have suggested that survival rates for this subgroup are the best current outcome measures with which to judge the performances of ACLS personnel[17,21] since time delays are not a factor in the resuscitation effort. Others have suggested that the underlying pathophysiology of this group differs from the group in whom collapses were sudden and unexpected.[21] Arrest-after-arrival patients have pain and symptoms that led them to call for emergency help, suggesting a thrombotic event. In contrast, the patient with sudden collapse may have experienced an electrical dysrhythmic arrest with minimal acute thromboses. However, the biological model of sudden cardiac death suggests that both mechanisms are operative.[15] Additional description of the arrest-after-arrival group should include rhythm identification, the time intervals indicated in Figure 2, and the clinical outcomes indicated in the lower portions of the Utstein Style Template.

10. Initial rhythm ventricular fibrillation and 12. initial rhythm asystole. Subdivisions of ventricular fibrillation such as *fine, moderate,* or *coarse* have limited clinical usefulness.[22,23] However, a specific distinction between fine ventricular fibrillation and asystole, although clinically and physiologically indeterminate, should be made for the purposes of uniform reporting.[22,23] The Utstein Style recommends a specific discrimination point between asystole and fine ventricular fibrillation: a deflection on the surface electrocardiogram of less than 1 mm amplitude (calibrated at 10 mm/mV) is asystole; 1 mm or more is ventricular fibrillation. Automated external defibrillators already use this criterion.[22,24–26]

11. Initial rhythm ventricular tachycardia. Because its outcome spectrum is different, consensus conference participants recommend that pulseless ventricular tachycardia not be grouped with ventricular fibrillation but instead have a separate template pathway. However, these patients make up such a small proportion of out-of-hospital cardiac arrests that they are often combined with the much larger number of ventricular fibrillation patients.

13. Other initial rhythms. This category includes rhythms in which some electrical activity is observed in a patient in cardiac arrest. The activity usually appears as ventricular escape complexes that probably represent the last electrical activity of a dying heart. For persons in confirmed cardiac arrest, there is little to be gained by detailed refinement of this category. *Electromechanical dissociation*, a poorly defined term that is undergoing redefinition,[27,28] should be grouped with other rhythms at present.

14. Determine presence of bystander CPR (see Glossary). This section of the template allows calculation of the percentage of cardiac arrests in which bystanders initiated CPR. A high percentage of early bystander-initiated CPR effort is associated with improved survival from cardiac arrest.[7,19,29–34] These data also assess other aspects of an EMS system's chain of survival and are important for program evaluation.[31] Note that the template is arranged for multiple analyses. For example, researchers can determine survival outcomes for persons in witnessed ventricular fibrillation who received early bystander CPR compared with those who received only late CPR from emergency personnel.

15. Any return of spontaneous circulation. The Utstein Style Template (Figure 4) accepts return of any spontaneous palpable pulse and does not require a specific pulse duration, for example, more than 5 minutes. A *palpable pulse* is detectable by manual palpation of a major artery, usually the carotid. This pulse implies a systolic blood pressure of approximately 60 mm Hg. Return of spontaneous circulation is clearly an intermediate outcome that may be evanescent. While it is less clinically important than hospital admission or eventual discharge, return of spontaneous circulation may be useful in clinical trials and other intervention studies. The number of patients who *16., never achieved return of spontaneous circulation* (see template) should be noted.

17. Efforts ceased: a. patient died in the field or (if transported) b. in the emergency department. Several studies confirm the futility of transporting cardiac arrest patients who have never achieved return of spontaneous circulation to emergency departments.[35,36] Successful outcomes for these patients are rare. Nevertheless, a number of systems require emergency personnel to transport victims with unsuccessful field resuscitations to the emergency department. The reporting template allows these patients to be recorded and permits assessment of outcomes. The template also allows notation of patients in whom emergency personnel terminated resuscitation efforts in the field without hospital transport. This practice is becoming more frequent in the United States.[37,38]

18. Admission to intensive care unit/ward. This level of the template refers to patients in whom return of

TABLE 1. Outcome of Brain Injury: The Glasgow-Pittsburgh Cerebral Performance and Overall Performance Categories[56,65]

Cerebral Performance Categories	Overall Performance Categories
1. Good cerebral performance. Conscious. Alert, able to work and lead a normal life. May have minor psychological or neurological deficits (mild dysphasia, nonincapacitating hemiparesis, or minor cranial nerve abnormalities).	1. Good overall performance. Healthy, alert, capable of normal life. Good cerebral performance (CPC 1) plus no or only mild functional disability from noncerebral organ system abnormalities.
2. Moderate cerebral disability. Conscious. Sufficient cerebral function for part-time work in sheltered environment or independent activities of daily life (dressing, traveling by public transportation, and preparing food). May have hemiplegia, seizures, ataxia, dysarthria, dysphasia or permanent memory or mental changes.	2. Moderate overall disability. Conscious. Moderate cerebral disability alone (CPC 2) or moderate disability from noncerebral system dysfunction alone or both. Performs independent activities of daily life (dressing, traveling, and food preparation). May be able to work part-time in sheltered environment but disabled for competitive work.
3. Severe cerebral disability. Conscious. Dependent on others for daily support because of impaired brain function (in an institution or at home with exceptional family effort). At least limited cognition. Includes a wide range of cerebral abnormalities from ambulatory with severe memory disturbance or dementia precluding independent existence to paralytic and able to communicate only with eyes, as in the locked-in syndrome.	3. Several overall disability. Conscious. Severe cerebral disability alone (CPC 3) or severe disability from noncerebral organ system dysfunction alone or both. Dependent on others for daily support.
4. Coma, vegetative state. Not conscious. Unaware of surroundings, no cognition. No verbal or psychological interactions with environment.	4. Same as CPC 4.
5. Death. Certified brain dead or dead by traditional criteria.	5. Same as CPC 5.

CPC, Cerebral Performance Categories.

spontaneous circulation was sustained long enough to merit admission to an intensive care unit/ward. For the purposes of standardization, consensus conference participants define a successful hospital admission as a patient admitted to the hospital with spontaneous circulation and measurable blood pressure, with or without vasopressors. The patient may or may not be breathing spontaneously and may or may not be intubated. The need for continuing CPR or mechanical CPR devices implies the absence of spontaneous circulation, and such patients should be excluded. Artificial circulatory assists such as emergency cardiopulmonary bypass and intra-aortic balloon pumps imply that spontaneous circulation is present, and such patients should be included. There is no duration requirement on successful admission.

19. Patient died in hospital: a. total and b. within 24 hours. Researchers should tabulate the number of patients who die in the hospital, with special notation of patients who die within the first 24 hours of admission. Patients who experience additional cardiac arrests during the index hospitalization are counted as a single person in the data analysis, whether or not they are successfully resuscitated.

20. Discharged alive. The number of patients discharged from the hospital alive should be noted. The discharge destination should also be noted—home, prearrest residence, rehabilitation facility, extended care facility (nursing home); and other duration of hospitalization. If possible and practical, researchers should record the "best-ever achieved" Cerebral Performance Category and Overall Performance Category (Table 1). If best-ever achieved presents collection difficulties, the Overall Performance and Cerebral Performance Categories at the time of discharge should be noted. These categories are discussed further under "Collection of Individual Clinical Data."

21. Death within 1 year of discharge. The date and cause of death in the first year of discharge should be recorded as core data to allow calculation of length of survival. The Overall Performance and Cerebral Performance Categories near time of death should be noted. The best overall performance and cerebral performance achieved between discharge and death should be recorded as supplementary data, although this may be difficult to determine.

22. Alive at 1 year. The Overall Performance and Cerebral Performance Categories of patients who survive for more than 1 year should be noted near the 1-year mark. The best Overall Performance and Cerebral Performance Categories ever achieved in that year should optimally be recorded as supplementary data. In persons who experience additional out-of-hospital cardiac arrests during their first year of survival, each cardiac arrest and resuscitation attempt should be treated as separate events.[39] Thus, a second cardiac arrest in the year after the index cardiac arrest marks the end of survival for the index event and is counted as a death, whether or not the person survived. If emergency personnel attempted to resuscitate this person in later events, that person would be counted in the template as an additional resuscitation attempted. If the person lived to be discharged from the hospital again, he or she would still be counted as a separate person.

Time Points and Time Intervals

Delay until treatment determines the immediate, intermediate, and overall outcomes in cardiac arrest.[7,9,13,19,31,32,40–43] The most powerful determinant of restoration of a beating heart is time intervals, specifically, the time interval from collapse to initiation of resuscitative efforts. Concomitantly, this interval is the major determinant of ultimate survival.[5,8,29,40] Research into cardiac arrest and evaluations of system performance depend on accurate determination of when specific events occurred and the time intervals between these events. Therefore, researchers must place great emphasis on determination of event times and the associated time intervals.

Systematic recording of event times should be an integral part of cardiac arrest management performed by a recognized member of the team. As such, it should figure prominently in training and testing of personnel. Training in citizen CPR should stipulate memorization of the time an arrest occurs and when basic CPR was started. Precision in recording time events is essential, and researchers should explore new technologies and methods that will increase accuracy.[44] However, improved data collection must not interfere with care or impose non-care work on field personnel.[33]

Figure 1 shows the complexity of recording time intervals of cardiac arrest. Four different clocks begin running when a cardiac arrest occurs and the EMS response begins. The *patient clock* begins with the patient's collapse and runs until effective circulation and respirations are restored. The *dispatch center clock* begins when the emergency call reporting the collapse is answered and ends after prearrival instructions, especially telephone-assisted CPR instructions, are delivered to the caller. The *ambulance clock* begins to run when the response vehicle starts to move and ends when the patient arrives at the hospital. Finally, the *hospital clock* begins with the patient's arrival at the emergency department and ends when the patient is discharged from the hospital or dies during hospitalization.

Figure 2 attempts to simplify the complex timing displayed in Figure 3. It depicts the major events associated with resuscitation attempts after cardiac arrest. These are the recommended time events that an emergency system should record. Each occurs at a single moment. The period between two time events constitutes the event-to-event interval. As noted previously, researchers should always use the term *interval,* not *time,* to refer to the time that passes between any two events (see Glossary). The label for the interval should state the two anchor events. Neologisms, jargon, and nonspecific terms that mistakenly use *time* instead of *interval* should be avoided. Examples of such terms include *downtime, response time,* and *time to definitive care.* The stacked index card design in Figure 2 shows that these events can occur in different sequences with different patients. In addition, variable space (intervals) between the cards for different patients is possible.

Recording the time events depicted in Figure 2 permits the tabulation of a large variety of intervals. Many, such as the call receipt–to–arrival at patient's side interval, are essential to quality assurance plans and system evaluation.[17] However, the two most important intervals from the perspective of patient survival are the collapse–to–first CPR attempt interval and collapse–to–first defibrillatory shock interval.[10,15,16,19,25,30–32,45–51]

Many EMS systems may decline to participate in multicenter research projects and shared data registries and thus will not need the complete supplementary detail recommended in Figure 2. However, these systems and responsible physicians will want to know what core data to collect for comparison of their performance with that of similar communities. Figure 2 indicates the core times to record: first bystander CPR, receipt of dispatch call, vehicle stops, first CPR by EMS personnel, first defibrillatory shock, return of spontaneous circulation, and CPR abandoned (death).

Recommended Core and Supplementary Time Events to Be Recorded

Time of collapse/time of recognition. Despite its importance as core information, imprecision surrounds the estimated time of collapse. Emergency personnel must ask additional questions of bystanders to identify this time. However, this information is essential to understand the ischemic interval.[4,5] It should be noted that time of collapse can be obtained *only* for witnessed cardiac arrests. The recommendations define a witnessed arrest as one in which collapse or signs of distress were seen (or heard) by an identifiable witness. Time of recognition is the time at which an unwitnessed arrest was discovered.

Time of call receipt (core). Modern emergency dispatching records this event automatically. If the message is passed from one dispatcher to another, the time the first operator was contacted should be listed as the time the call was received.

Time first emergency response vehicle is mobile. For precise data collection, this is defined as the moment when the emergency response vehicle begins to move. Prolonged intervals between the time the call was received and the time the vehicle began to move may be due to long call-processing intervals or slowness of personnel.

Time vehicle stops (core). This is the time when the emergency response vehicle stops moving, at a location as close as possible to the patient. This term replaces the commonly used phrase *time of scene arrival,* whose meaning ranged from *destination visually spotted* to *personnel at patient's side.*

Time of arrival at patient's side. If possible, the moment of arrival at the patient's side should be recorded. However, it is difficult to determine the time interval from leaving the emergency response vehicle to beginning resuscitation, though new defibrillator features now make this possible.

Time of first CPR attempts (core). The time of first CPR attempts should be recorded both for bystander-initiated CPR and for CPR initiated by emergency personnel. Note in Figure 2 that personnel should also record the time when additional CPR is considered futile and chest compressions and ventilations cease. Although this generally would be time of death, some systems require that a physician officially pronounce death.

Time of first defibrillatory shock (core). Early defibrillation is the foundation for success in resuscitation of patients in ventricular fibrillation. EMS systems should focus attention toward recording the moment in real time when the first defibrillatory shock is delivered. The time interval from collapse to first defibrillatory shock serves as a key evaluative measure for many other components of an emergency system. This time interval is reduced by the competence of bystanders who recognize a cardiac arrest and respond with a rapid telephone call, the efficiency of the dispatch system that processes calls quickly and activates the appropriate responding unit, and the skills of early defibrillation units that gain access to the patient and perform their protocols rapidly. The best way to obtain this information is through automated external defibrillators or conventional defibrillators with automated event documentation. These devices provide precise details on initial rhythm, times, and responses of heart rhythm to therapy. The value of such technology is obvious, and its use should be more widespread.

Time of return of spontaneous circulation (core). (See "Template Sections.")

Time intubation achieved. As with defibrillation, airway management is a critical intervention for CPR. Emergency personnel should record the time of intubation if they can do so accurately and without interfering with patient care. Return of spontaneous ventilation occurs when voluntary respiratory efforts, including agonal-like gasping, begin. This may be extremely difficult for field emergency personnel to record accurately, often because agonal-like gasping may not have ceased before intubation.

Time intravenous access achieved and time medications administered. Research has not yet established the true incremental value of intravenous or endotracheal medications used in cardiac resuscitation.[52–54] Nevertheless, the effectiveness of these agents is time dependent. Recent evidence suggests that assignment of defibrillation tasks to the first responding emergency medical technician personnel not only shortens the interval from collapse to defibrillation for patients in ventricular fibrillation but also significantly reduces intervals to intubation and administration of medication.[55] The consensus conference participants encourage documentation of these time points.

Time CPR abandoned/death (core). Emergency personnel should record the time at which resuscitation efforts—specifically, chest compressions and CPR ventilation efforts—were terminated outside the hospital.

Departure from scene and arrival at emergency department. Emergency personnel can record these times easily and accurately. Various related intervals are key components for effective quality assurance and general management. These include *vehicle stops–departure from scene interval, departure from scene–arrival at hospital interval,* and *vehicle rolling–departure from hospital interval* (so-called *personnel out-of-service interval,* meaning personnel are not available for other care activities).

Collection of Individual Clinical Data

Clinical Outcomes

The clinical outcomes following attempted resuscitations are the core information required for system evaluation, intersystem comparisons, and clinical trials. The chief goal of cardiocerebral resuscitation is to return the patient to his or her prearrest level of neurological function. This goal mandates that evaluation of resuscitation efforts cannot be complete without assessment of neurological outcome in two dimensions, quality[5,56] and duration.[41,57–64] Elaborate efforts at improving survival from cardiac arrest may yield only short-term survival. Such patients may survive only after expensive stays in intensive care units and recover only to undesirable levels of neurological function. Researchers need these data to show that resuscitation efforts have a net positive benefit to society, to families, and to patients.

The Glasgow-Pittsburgh Outcome Categories

The Glasgow-Pittsburgh Outcome Categories have become the most widely used approach to evaluate quality of life after successful resuscitation.[56,65] Clinicians designed these categories to evaluate cardiac arrest survivors. The categories differentiate the cerebral effects of the cardiac arrest from the morbidity of underlying, noncerebral problems.[40,65–67] The Overall Performance Categories reflect cerebral and noncerebral status and evaluate actual overall performance. The Cerebral Performance Categories evaluate only cerebral performance capabilities. These outcome categories are reliable and easy to obtain and often require only a telephone call to family members. An alternative and even more simple approach is to record the time of awakening or return to consciousness.[59,60] Both the Glasgow-Pittsburgh Outcome Categories and time of awakening have the advantage of simplicity and practicality, especially when compared with more elaborate interview and physical assessment methods.[68,69]

The Utstein Consensus Conference participants recommend use of the Glasgow-Pittsburgh Outcome Categories to record prearrest status, status at the time of discharge, and status after 1-year survival. The Glasgow-Pittsburgh Outcome Categories feature two 5-point parallel scales, the Cerebral Performance Categories and the Overall Performance Categories. Category 1 is conscious and normal, without disability. Category 2 is conscious with moderate disability. Category 3 is conscious with severe disability. Category 4 is a comatose or vegetative state. Category 5 is death. To illustrate, a conscious, mentally normal person who is bedridden with severe heart disease would have a Cerebral Performance Category of 1 and an Overall Performance Category of 3. Table 1 describes the Glasgow-Pittsburgh Outcome Categories in detail.

A single data collection form. Many experts recommend the development of a single form for data collection for use in all EMS systems. Such a form, called a *cardiac arrest registry form, run report, run record,* or *medical incident report,* allows shared data bases, patient registries, and true multicenter studies. These forms must record clinical, epidemiological, and evaluative data. However, in most systems, incident report forms must also provide data for medicolegal, administrative, management, and personnel tasks. These system-specific tasks include resource allocation, staffing, and personnel scheduling. A single data collection form cannot serve all functions for all EMS systems. However, the data collection form for individual patients can at least provide the core data that will allow completion of the clinical portions of the Utstein Style Template.

Recommended clinical data. The Utstein Consensus Conference participants recommend that responsible personnel should attempt to record the clinical data listed below for each attempted resuscitation:

- Site of cardiac arrest (core): home, street, public place, work place, mass gatherings, ambulance, nursing home, or other long-term care facility
- Prearrest clinical status (supplementary): Overall Performance Category and Cerebral Performance Category
- Witnessed arrest before arrival of emergency personnel (core): yes or no
- Precipitating event (supplementary) (determined as best possible at the scene): acute cardiac event, trauma, exsanguination, hypoxia, intracranial event, intoxication (drug ingestion), metabolic, drowning, sepsis, or sudden infant death syndrome. An attempt should be made to classify the arrest as cardiac or noncardiac core data.
- Clinical status of patient when ambulance arrives (core): breathing (yes/no), palpable pulse (yes/no), bystander CPR (yes/no)
- Arrest after arrival of emergency personnel (core): yes or no
- Initial recorded rhythm (core): ventricular fibrillation, ventricular tachycardia, asystole, and other
- Treatment (core): The specific protocols used by a system should be listed when the EMS system is described. However, for individual patients, personnel should record the specific interventions used. As core information, personnel should record the type of respiratory support provided (mouth-to-mouth or mask breathing, endotracheal intubation, or other type of airway management), whether intubation was successful, number of defibrillatory shocks given, and medications administered. The strong association between unsuccessful resuscitation attempts and numerous interventions is obvious—the more difficult a resuscitation, the more interventions used. Consequently, an account of interventions in unsuccessful attempts provides little information of value. Researchers must therefore emphasize all interventions used for persons who regained spontaneous circulation.
- Final patient status at the scene (core): This refers to the condition of the patient when either transport begins or efforts terminate. The recommended categories are return of spontaneous circulation, continuing CPR, or death (CPR efforts stopped; specific time recorded).
- Status on arrival at emergency department (supplementary): This information reflects a change in status during transport. The possibilities are continuing CPR, pronounced dead on arrival (record specific time), or the presence of spontaneous circulation. If the return of spontaneous circulation lasts more than 5 minutes, blood pressure, respiratory rate, and the Glasgow Coma Score should be recorded. The patient's temperature should also be recorded, especially in arrests associated with hypothermia.
- Status after treatment in the emergency department (core): The possibilities are admission to the hospital intensive care unit or alternative location or pronounced dead with termination of efforts (specific time recorded).
- Status on admission to hospital unit (supplementary): The Glasgow Coma Score, blood pressure, rate of spontaneous respirations (if any), and basic brain-stem reflexes should be recorded.
- Discharged alive (core): If the patient died in the hospital, the date and time of death and length of survival after return of spontaneous circulation should be recorded. Patients who died within 24 hours should be noted (in exact time). The Overall Performance Category and Cerebral Performance Category at time of discharge should also be recorded (supplementary). If the person dies before surviving 1 year, the best score achieved in the week before death should be recorded. Supplementary data to be recorded should include the best-ever outcome achieved during hospitalization and in the year after the arrest, although these data may be difficult to gather in a practical manner.
- Discharge destination (supplementary): If the patient is discharged, researchers should record the discharge destination: home (or prearrest residence), rehabilitation facility, extended care facility (nursing home), or other.
- Alive at 1 year (yes/no) (core). If yes, the Overall Performance Category and Cerebral Performance Category scores at 1 year should be recorded. Personnel can often obtain these scores through telephone interviews with family members. If the person dies in the first year, the date of death and the length of survival should be recorded. Supplementary data include the best Cerebral Performance Category achieved.

Description of EMS Systems

The organization of a community's EMS system has a major effect on cardiac arrest outcomes.[10,29,70] The Utstein Consensus Conference participants recommend that a report of cardiac arrest survival describe the community's EMS system.[7,8,17,71] Researchers should describe the dispatch component of an EMS system as well as the various response tiers. These descriptions should state who makes up each tier, what interventions and actions they provide, how they provide those interventions (and how well), and when they deliver their care.[72] Described below are the many dimensions of an EMS system that researchers and system managers should know. Although it would be impractical to report each of these details in every publication, as much of the recommended core data as possible should be provided.

The Dispatch System

Who (supplementary). It should be stated whether dispatchers must have special skills, such as emergency medical technician, paramedic, nurse, or physician training, and whether they are full-time salaried employees or volunteers. The average number of hours of training received should be described, as well as whether a formal emergency medical dispatching course is required.[73] In addition, the report should state the average number of medical emergency calls the EMS system handles per year and the estimated number of calls handled by each dispatcher each year.

What (core). The dispatch system should be described in terms of whether it is dedicated to EMS only or whether it also covers fire and police. The type of communication system used should be stated, that is, 911, enhanced 911, 999, a seven-digit number, or computer-aided dispatch.

How (supplementary). It should be stated whether formal protocols for dispatching are in use. Is dispatcher-assisted CPR instruction offered to callers who report potential cardiac arrests?[74–76] Do dispatchers provide prearrival instructions to callers? Is simultaneous dispatching used for cardiac arrest patients? Can dispatchers send emergency vehicles during event interrogation? How are calls routed, and how many operators are involved from the time the call is received until the vehicle starts to move?

When (core). The median interval for dispatch call-processing, defined as the time from when the call is first received to when the emergency vehicle leaves (call receipt–to–mobile vehicle interval), should be stated.

First Tier: The First Emergency Personnel to Arrive

Who (supplementary). Each system should describe how personnel in this response tier are designated (physicians, nurses, ambulance personnel, emergency medical technicians, or first responders). The organizational affiliation of the personnel should be stated in terms of dedicated EMS service, mixed EMS–fire service, hospital based, private ambulance company, or other and whether personnel are authorized to transport patients. The following features should also be described: total number of personnel in this tier, status (paid versus volunteer), number of hours of training, number of team members per response unit, number of vehicles in service at a given time, and number of responses per community per year.

What (core). The major interventions permitted for use in cardiac resuscitation should be described. In broad categories these include CPR, defibrillatory shocks, intravenous medications, and technical airway management. Each of these categories should be described in enough detail to provide a clear picture of what an EMS system does for someone in cardiac arrest.

A description of CPR should state whether personnel use manual or mechanical chest compression devices. The method of technical airway management used should be stated, that is, bag-valve-masks, pocket face masks, or other upper airway devices. Are esophageal obturators, laryngeal masks, or pharyngotracheal airways used? It should be specifically stated if the EMS system authorizes endotracheal intubation or the use of paralytic agents in difficult intubations, and whether personnel can perform cricothyrotomies. If defibrillation is permitted, the generic type of defibrillator used should be noted. These include automated external defibrillators and conventional (manual) defibrillators. It should also be stated whether transcutaneous pacing with free-standing pacemakers or pacemakers combined with defibrillators is permitted.

If the use of pharmacological agents is authorized, the routes of delivery should be described (intramuscular, intravenous, central line, endotracheal, and interosseous). Medications that personnel can administer to patients in cardiac arrest should be specified.

How (core). General resuscitation protocols should be described in terms of sequence and type of intervention and whether the protocols adhere to those recommended by a consensus group such as the American Heart Association[13] or the European Resuscitation Council. Do personnel follow standing orders or do they need to obtain radio or telephone permission before initiating therapy?[77] At what point must personnel contact the base station or medical control physician? If field personnel must transport patients with continuing CPR, what are the criteria for when they must begin to prepare the patient for transport? Does the EMS system permit field personnel to cease resuscitation efforts in the field? At what point do the protocols permit cessation of efforts, and what are the criteria for doing so?

How well (supplementary). Researchers should provide some statements about the quality of personnel performance. In regard to interventions, the most important performances to review are the percentage of persons in ventricular fibrillation who underwent defibrillation, the percentage of attempted intubations that are successful, and the percentage of persons for whom an intravenous line is accomplished. In regard to personnel, the most important performance dimensions to report are success rates for attempted intubations and for attempted intravenous lines. Measurements of these performance criteria are obviously fraught with difficulties and reporting inaccuracies and will not be available in all systems and at all times. The consensus conference recommendations focus on achieving as much objectivity in these measures as possible.

When (core). The median (not mean) call response interval for the various tiers of the response system should be described (see Glossary). Mean intervals are inappropriately distorted by long times. The supplementary data an EMS system should present is a cumulative response interval curve. Such a curve should display the median response intervals for 25%, 50%, 75%, and 90% of cardiac arrest responses, and the number of observations on which these median times are calculated should also be stated.

Second and Third Tiers: The Second and Third Types of Emergency Personnel to Arrive

In most locations in the United States, paramedics compose the second tier[7] of emergency personnel to arrive. There is no third tier.[7] In Europe there often is a second or third tier consisting of emergency physicians who respond outside the hospital. These additional tiers must be described in the same detail and same features as noted above for the first responding tier (referring to core and supplementary recommendations). In addition, a supplementary comment on the method used to activate this tier should be provided. Do dispatchers call this tier when a cardiac arrest is first reported, or must the second tier await a call from the first tier? How often does the second tier arrive before the first?

Discussion

This report presents recommended guidelines for uniform reporting of data from cardiac arrest. The concept of a consensus conference to address the topic of reporting guidelines and nomenclature has precedents. In 1978 a group of biomedical journal editors met in Vancouver, British Columbia, and discussed the similar problem of inconsistent presentation formats and contents for scientific manuscripts.[78,79] Their recommendations for uniform technical requirements for manuscripts submitted to biomedical journals are known as the *"Vancouver Style."*[80] The International Committee of Medical Journal Editors continues to publish updates of the original Vancouver Style.[81,82]

The Utstein Style as recommended in this report may have a similar positive effect on manuscripts submitted for publication to medical journals.[83] The absence of uniform reporting has led to a tower of Babel[8] in articles about cardiac arrest. Researchers have documented differences in survival rates among many different cities, differences that remain unexplained because of inconsistent and obscure terminology.[7] Whether these variable survival rates are due to differences in system organization, differences in treatment protocols, or differences in the skill levels of personnel remains unknown.[8]

Many previous studies failed to provide sufficient information to help the reader understand how persons in cardiac arrest are treated. Outcomes are particularly difficult to compare because the terminology in reports is inconsistent. A successful *save* or *resuscitation* may mean *return of a pulse for at least 5 minutes* in one system, *admission to the hospital* in another, and *discharged alive from the hospital* in a third. Even the terms *CPR* and/or *cardiopulmonary resuscitation* have important differences in usage. In one area, *CPR* means the act of performing external chest compressions and expired air mouth-to-mouth ventilation; in another, it means the complete return of spontaneous circulation and ventilation. Because of this inconsistency in reporting, no true standard exists for the survival rate that can (or should) be achieved by communities.

A number of problems follow from this confusion in nomenclature. Researchers, clinicians, and emergency care managers cannot identify the relative benefits of different system approaches to the treatment of sudden cardiac arrest. EMS systems, hospitals, and cardiac care units do not have adequate performance indicators for their particular type of system, and their system cannot be compared to a recommended standard or other similar systems. Therefore, true quality assurance is not available.

In addition, it becomes impossible to tell the relative merits of different organizational approaches. The widely accepted and widely endorsed "chain of survival" concept has expanded the complexity of our thinking about the organization of EMS systems.[31] A new communitywide CPR program or a new early defibrillation program must be carefully inserted as a new link in the EMS continuum. This continuum includes early access, early CPR, early defibrillation, and early advanced care. However, system managers find it difficult to plan for reorganization or the addition of new components because they lack information on the incremental value of these new programs. New systems hoping to develop a reasonably effective approach cannot review the published materials on system organization with confidence. They want to avoid duplication of unnecessary activities and repetition of avoidable errors, and they want to know quickly, given their local resources, which of several EMS approaches will be most effective. The Utstein guidelines should support the performance of intrasystem and intersystem evaluations, intrasystem evaluations supporting local quality improvement programs and intersystem comparisons helping identify the relative benefits of different system approaches.

Standardization of nomenclature also provides the means to evaluate important trends in emergency cardiac care that are now under way. For example, early defibrillation is spreading rapidly, stimulated by the new technology of automated external defibrillators.[24–26,84] Many systems, including hospital and outpatient settings, are giving this approach serious consideration.[25,26,85–87] However, they need to know the relative merits of alternative approaches. Managers and medical directors have started to seriously examine the economic effect of widespread use of paramedics, in both the United States and Europe, and ambulance-doctors in Europe. Do these services really produce enough clinical differences to justify their implementation?[88,89]

A trend in the opposite direction is physician oversupply or "doctor-unemployment" in some parts of the world. In these locations, the tendency of management is to emphasize the professional status of ambulance-doctors. Physicians then consider such positions more attractive alternatives when they search for clinically interesting work. This tendency produces a reluctance to delegate special physician skills such as defibrillation and intubation to nonphysicians.[90] Paramedic and early defibrillation programs consequently receive less support. Only the steady accumulation of valid research and reports can determine the relative merits of the respective systems. This research requires that all investigators start at the same point, use the same vocabulary, and collect comparable data.

A number of other benefits will follow the use of a uniform terminology and common reporting approaches. These guidelines will encourage studies that could yield a better epidemiological picture of the problem of cardiac arrest. Appropriate studies could then focus on the factors that determine survival. This research may identify special high-risk subgroups or specific interventions to reduce mortality. These guidelines would also permit more rigorous single and multicenter studies on cardiopulmonary arrest. Areas of research might include the therapeutic effects of medications, different system organizational approaches such as widespread first responder defibrillation, and innovative interventions such as more widespread public education about early recognition of cardiac pain and cardiac arrest.

The consensus conference participants recognize that their recommendations will have value only as they are used to examine a variety of emergency medical systems. When a number of locations use these recommendations, in particular, the reporting template, a guiding standard or overall performance standard can emerge. Improvement can follow as systems adopt the approaches and system designs that appear to be the most successful. Continuous quality improvement, a goal of all EMS systems, can be achieved.

The consensus conference participants recognize that certain features of the Utstein guidelines will need to be revised and supplemented. Comments or questions on these recommendations are welcome. Comments from North America and Australia should be sent to Richard O. Cummins, Center for Evaluation of Emergency Medical Services, Seattle–King County Department of Public Health, 110 Prefontiane Place S, Suite 500, Seattle, WA 98122. Comments from other parts of the world should be sent to Douglas Chamberlain, Cardiac Department, Royal Sussex County Hospital, Eastern Road, Brighton, East Sussex, England BN2 5BE. Letters from organizations that wish to participate in future meetings of the consensus conference should be similarly addressed.

Dedication

These recommendations from the two Utstein Consensus Conferences are dedicated to Professor Peter Safar. Many of our definitions and perspectives are based on his contributions. Professor Safar has brought new understanding to the pathophysiology of cardiac arrest and resuscitation. He continues to be an inspiration to us all.

Acknowledgments

Peter Safar provided valuable insights and comments for this special report. The Laerdal Foundation for Acute Medicine provided a grant to support the Utstein Consensus Conferences.

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