Special Report

Recommended guidelines for reviewing, reporting, and conducting research on in-hospital resuscitation: the in-hospital 'Utstein style'

A Statement for Healthcare Professionals From the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, the Australian Resuscitation Council, and the Resuscitation Councils of Southern Africa

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We do not know the true effectiveness of in-hospital resuscitation. Observed results of the many published studies vary greatly. Studies originate from different settings and have different patient populations. Reports suffer from nonuniform nomenclature and variable inclusion definitions. Patients differ in the extent of co-morbid conditions and interventions in place at the time of cardiac arrest. These differences prevent valid interhospital and intrahospital comparisons and make determining the effectiveness of current resuscitation techniques impossible.

To develop these guidelines the task force used a consensus development process that originated with the 'Utstein style' for reporting outcome data from out-of-hospital resuscitation events. Task force members performed an integrated review of published studies. An initial draft was prepared, discussed, and revised at a 2-day conference. Further drafts were revised and circulated among task force members and discussed face-to-face at three subsequent meetings.

The task force defined a set of data elements that are essential or desirable for documenting in-hospital cardiac arrest. Data categories are hospital variables, pa-
tient variables, arrest variables, and outcome variables. The 'In-Hospital Utstein-Style Template' was developed to summarize these data and recommendations for reporting a specific set of survival rates and outcomes. The task force recommends that four critical intervals be included, whenever possible, in all reports of in-hospital resuscitation: collapse to cardiopulmonary resuscitation (CPR), collapse to first defibrillation, collapse to advanced airway management, and collapse to administration of first resuscitation medications. The task force also developed the Utstein-style 'Standard Reporting of In-Hospital Cardiopulmonary Resuscitation' form, which hospitals can use to record cardiac arrest data for individual patients.

Collection of the recommended variables will enable intrahospital and interhospital comparisons and support national and international research. Collection and review of these data should improve patient care and event documentation for individual patients and reduce medical legal risks. These recommendations, however, are only a beginning. Definitive recommendations for in-hospital resuscitation require additional research. CPR remains a dramatic medical intervention with both indications and contraindications. Resuscitation activities must be conducted ethically, with concern for the principles of patient self-determination and death with dignity and for the sensitivities of family and friends.

1. Background

1.1. Growth of resuscitation activities

Since the rediscovery of the effectiveness of closed chest compression in 1960, medical personnel have made CPR one of the most frequently performed medical interventions in the world. Organizations such as the AHA, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, the Australian Resuscitation Council, and the Resuscitation Councils of Southern Africa have developed practical clinical guidelines for emergency cardiac care.

The Emergency Cardiac Care programs of the AHA and equivalent training programs teach techniques of basic life support (BLS) and advanced life support (ALS) to both in-hospital and out-of-hospital emergency personnel. These programs serve to encourage citizen CPR. Versions of these programs have spread to most communities and hospitals in the developed world. Training equipment, educational materials, and personnel costs associated with this training represent more than a billion dollar 'industry' in the United States alone [1]. The resuscitation councils of many countries have implemented similar programs and are establishing training networks to ensure that hospital professionals learn and can use recommended procedures.

In the United States hospital accreditation requirements specifically mandate that hospitals develop a planned response to in-hospital cardiac emergencies. Most accredited US hospitals require that medical and nursing staff who respond to cardiac arrests be trained in BLS and advanced cardiac life support (ACLS). This requirement has encouraged the growth of a large emergency cardiac care training industry in the United States. Many hospitals in Europe, Australia, Canada, and South Africa, as well as in countries outside these areas, have mandated or plan to establish similar programs.

In addition, resuscitation is an active and growing subject of academic inquiry. Throughout the world researchers seek the most effective interventions and techniques to resuscitate people after cardiopulmonary emergencies. The journal *Resuscitation* publishes reports of such research, and other major medical journals devote considerable attention to resuscitation topics.

Nevertheless, the true effectiveness of many aspects of resuscitation remains unknown despite the huge investment of scientific and healthcare resources [2–9]. For example, we do not know the value of antiarrhythmic or adrenergic agents given for cardiac arrest, [9–11] nor do we know the true effectiveness of training programs in emergency cardiac care [3,12]. How well do people learn, and can they remember what they learn [5]? Will they perform these skills in a true emergency [4,13,14]? Although several investigators have observed that the quality of resuscitation attempts in terms of objective process criteria improve after formal CPR training, [6–8] significant differences in the critical outcome of survival rates have not been recorded. Finally, it is not firmly established that the correct use of resuscitation protocols, even by formally trained emergency personnel, influences patient outcome [2].

During the late 1980s and early 1990s, resuscitation researchers began to systematically examine the effectiveness of current resuscitation procedures [15]. The International Liaison Committee on Resuscitation has sought to evaluate available scientific data related to resuscitation protocols [16]. A continuing scientific review of animal and human resuscitation research has led investigators to ask whether the data justify changes or additions to the clinical guidelines. This effort is an attempt to remove anecdotal evidence, subjective impressions, and proclaimed affirmations from resuscitation protocols.

This critical review has been sobering. Few resuscitation interventions are based on valid scientific data. Proper randomized, controlled clinical trials focused on sudden cardiac death, and unexpected resuscitations are difficult, if not impossible, to perform. Many existing
resuscitation practices are driven by pathophysiological and nonquantitative reasoning rather than by evidence-based medicine. Resuscitation guidelines often present 'best guesses' rather than authoritative conclusions.

1.2. Results from in-hospital resuscitation efforts: variations in reported success

For more than 30 years researchers have published many studies on survival after in-hospital CPR. Until recently no clear picture of success had emerged. Three major reviews of more than 50 published articles on survival after in-hospital CPR have demonstrated wide variations in survival [17–19]. McGrath [17] calculated survival rates of 38% at 24 h (range 13% to 59%) and 15% at hospital discharge (range 3% to 27%). Debard [18] reported survival rates of 39% at 24 h and 17% at discharge to home. Cummins and Graves [19] reviewed 44 studies and calculated survival rates to hospital discharge that ranged from 3% to 27% following an in-hospital cardiac arrest. Such wide variations in the rate of survival are explained largely by marked differences in inclusion criteria and outcome definitions.

Two large-scale projects provide the best evidence on success of in-hospital resuscitation. The Belgian Cardiopulmonary Cerebral Resuscitation Registry (BCCRR), working with the European Resuscitation Council, gathers information on survival from both in-hospital and out-of-hospital resuscitation [20,21]. In the British Hospital Resuscitation Study (BRESUS), investigators analyzed the results of 3765 attempted cardiopulmonary resuscitations in 12 teaching and nonteaching hospitals throughout the United Kingdom [22]. Neither of these projects, however, are exclusively focused on in-hospital resuscitation. In BRESUS 25% of patients experienced onset of arrest during the prehospital phase. Investigators observed that 39% of patients survived the immediate arrest, 28% were alive 24 h later, 17% were discharged from the hospital, and 12.5% survived for 1 year. Both BRESUS and BCCRR helped pioneer standard methods of recording arrests for audit, clinical trials, and community studies. These studies provide a yardstick for comparing results from selected UK and Belgian hospitals with those obtained in other countries and for helping assess the effect of subsequent management changes.

1.3. Origin of the Utstein style and extension to in-hospital arrests

The Utstein style for reporting cardiac arrests arose from a 1990 conference at the ancient abbey of that name on an island near Stavanger, Norway. That conference and a another later that year were attended by representatives of the AHA, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, and the Australian Resuscitation Council. The results of these meetings have been previously reported [23–30]. The major concern was that the results of resuscitation endeavors in different countries, and even within countries, could not be compared meaningfully. Researchers have used disparate end points to assess the effectiveness of different systems and interventions. Useful comparisons have been prevented by this lack of uniform definitions and standard methodologies.

The Utstein style has attracted wide interest and has become a familiar term among members of the resuscitation community. Many researchers and system directors have adopted the Utstein templates, style, and nomenclature to report results of prehospital resuscitation. The success of this international initiative soon led to uniform international styles for reporting the results of pediatric resuscitation [31] and experimental (laboratory) resuscitation [32].

This report continues the Utstein style process by including adult in-hospital resuscitation within the international reporting agreements. These guidelines and recommendations can improve the scientific design of research projects and increase the clinical usefulness of published studies [33]. Improved projects and publications will provide consistent and reliable evidence on which to base treatment decisions. Uniform definitions and methodology will support valid interpretations of findings across multiple studies and permit more accurate integrative reviews and meta-analyses of resuscitation studies.

1.4. In-hospital resuscitation

In-hospital resuscitation presents unique challenges for research and evaluation. In 1990 the original Utstein Task Force considered including in-hospital resuscitation in the uniform guidelines [24] but postponed doing so because of its daunting complexity. Critical problems needed to be resolved: inconsistent definitions used in the description of resuscitation emergencies and outcomes, comorbid factors and severity adjustments for the victims, and the effects of interventions already in place at the time of arrest.

A cardiac arrest is defined in the Utstein style as 'the cessation of cardiac mechanical activity...confirmed by the absence of a detectable pulse, unresponsiveness, and apnea (or agonal respirations)' [24,30]. A hospital patient, however, may have many degrees of cardiac and pulmonary dysfunction that cannot be characterized as cardiac arrest, such as hypotension or shock. A patient's respiratory status can range from normal to agonal or gasping breaths to apnea, or the patient may be on artificial ventilation.

A hospital patient needing resuscitation could have comorbid conditions that may or may not influence
resuscitation outcome. For example, comorbid conditions could be unrelated to resuscitation outcome (e.g., hysterectomy for uterine fibromas), moderately related (e.g., acute pneumococcal pneumonia), or strongly related (e.g., acute pulmonary edema after myocardial infarction). Moreover, comorbid and pre-existing conditions may vary greatly in severity; for example, acute pneumococcal pneumonia may vary greatly in extent of organ involvement and in severity. Almost every publication on in-hospital resuscitation has neglected to allow for the magnitude of comorbid conditions.

2. In-hospital Utstein variables

To improve reports of in-hospital resuscitation, the Utstein Task Force identified four sets of variables that required further definition: hospital variables, patient variables, arrest variables, and outcome variables (Fig. 1).

No hospital, researcher, quality improvement advocate, or process evaluator will be able to collect all of these variables. Much of the data discussed will be collected only for specific purposes. For example, resuscitation attempts are critical events in the care of a patient that should be recorded as a vital part of the patient’s medical record. Often these data are recorded incompletely and inaccurately in the rushed turmoil of in-hospital resuscitation. The minimum data elements related to individual resuscitation attempts that should be collected are defined.

Outcome measurements for interhospital or intrahospital comparisons or specific research projects require a description of the context of the resuscitation. This context includes hospital variables as well as patient variables. Definitive evaluation of resuscitation efforts requires measurement of outcome variables, either immediate, intermediate, or long-term. Outcome evaluations, however, require following the patient outside the hospital, a task that requires a large amount of time, energy, and personnel resources.

2.1. Patient variables

Table 1 lists the patient variables that the task force recommends be reported. In selecting the required variables, the task force sought to include variables for which there is evidence of an association with differences in survival rates. Table 1 defines these variables and provides directions or comments for their use. Many of these variables are self-explanatory and descriptive. The definitions and directions for some variables are expanded below.

2.1.1. Age

Some studies have linked older age to poor outcome following out-of-hospital cardiopulmonary arrest and resuscitation [34–37]. In other studies, however, age alone was not shown to be an independent determinant of survival [38–47]. The observed differences in the effect of age on out-of-hospital and in-hospital arrest survival are difficult to separate from the effects of comorbid conditions [47].

Age categories should, at a minimum, separate pediatric data from adult data and should stratify the adult population. Adolescents are a difficult group to classify
<table>
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<tr>
<th>Data element</th>
<th>Definition</th>
<th>Priority</th>
<th>Directions or comments</th>
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<tbody>
<tr>
<td><strong>Patient variables</strong></td>
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<tr>
<td>Patient name (collect for medical</td>
<td>Someone who occupies a hospital bed; no duration of occupancy required.</td>
<td>Essential</td>
<td>Tabulate separately outliers who have events inside the hospital and patients who have</td>
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<td>record, not data reports)</td>
<td>(e.g., &gt;24 h)</td>
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<td>events in-hospital but whose original arrest was outside the hospital. Patient</td>
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<td>confidentiality must be respected in all data acquisition and reporting. In U.S.,</td>
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<td>social security number recommended; may be hospital number. Patient</td>
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<td></td>
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<td></td>
<td>confidentiality must exist.</td>
</tr>
<tr>
<td>Patient identifier</td>
<td>Allows tracking of all hospital and subsequent audit records.</td>
<td>Essential</td>
<td>Record as dd/mm/yr.</td>
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<tr>
<td>Date of birth</td>
<td>Self-explanatory</td>
<td>Essential</td>
<td>Record as dd/mm/yr.</td>
</tr>
<tr>
<td>Date of admission</td>
<td>Self-explanatory</td>
<td>Essential</td>
<td>Record as years and months/12 for patients &lt;21 yr.</td>
</tr>
<tr>
<td>Age</td>
<td>Self-explanatory</td>
<td>Essential</td>
<td>Record as male, female, unknown.</td>
</tr>
<tr>
<td>Gender</td>
<td>Self-explanatory</td>
<td>Essential</td>
<td>Record in metric scale. Essential for infants and children.</td>
</tr>
<tr>
<td>Height</td>
<td>Self-explanatory</td>
<td>Essential</td>
<td>Record in kilograms. Essential for infants and children.</td>
</tr>
<tr>
<td>Weight</td>
<td>Self-explanatory</td>
<td>Essential</td>
<td>Record as yes, no, or unknown. For yes, indicate whether it was monitored or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>unmonitored.</td>
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<tr>
<td>Witnessing/monitoring of event</td>
<td>Resuscitation emergency was seen, heard, or monitored.</td>
<td>Essential</td>
<td>Record as general care floor, emergency department, operating suite, intensive care</td>
</tr>
<tr>
<td>Location of event</td>
<td>Area of hospital where event was recognized.</td>
<td>Essential</td>
<td>unit, coronary care unit, postanesthetic recovery area, diagnostic or treatment unit,</td>
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<tr>
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<td>outpatient evaluation unit, or other in-hospital area.</td>
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<tr>
<td>ALS interventions in place at time</td>
<td>Interventions in place and available at time of event.</td>
<td>Essential</td>
<td>Record the following: endotracheal intubation, mechanical ventilation, IV access,</td>
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<td>of event</td>
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<td>intra-arterial catheterization, IV medications, and implantable defibrillator-</td>
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<tr>
<td></td>
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<td>cardioverter.</td>
</tr>
<tr>
<td>Previous cardiopulmonary events</td>
<td>Location and number of previous full cardiac events that</td>
<td>Desirable</td>
<td>Record the number of previous cardiac events in the following categories: out-of-hospital;</td>
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<td>required resuscitation attempts; previous events must have occurred &gt;24</td>
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<td>in-hospital, prior admissions; in-hospital, same admission (only if &gt;24 h before</td>
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<td>h before index event.</td>
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<td>index arrest).</td>
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<tr>
<td>Reason for admission</td>
<td>Full clinical details and diagnoses may not be immediately available to</td>
<td>Desirable</td>
<td>Record as cardiac (medical and surgical); noncardiac, medical; surgical, procedural</td>
</tr>
<tr>
<td></td>
<td>the event team. Summary categories can be used.</td>
<td></td>
<td>(scheduled/elective, scheduled/nonelective, or nonscheduled/emergent); or trauma,</td>
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<td></td>
<td></td>
<td></td>
<td>multiple reasons.</td>
</tr>
<tr>
<td>Pre-event functional capacity</td>
<td>Use CPC score based on chart review, family or staff interviews, and</td>
<td>Desirable</td>
<td>See detailed definitions of CPC score under 'Outcome variables' below. Use pediatric</td>
</tr>
<tr>
<td></td>
<td>information recorded at admission.</td>
<td></td>
<td>modifications for patients &lt;18 yr. [31]</td>
</tr>
<tr>
<td>Comorbid conditions</td>
<td>Major medical and surgical conditions present at time of event and</td>
<td>Desirable</td>
<td>Record major ICD-9-CM codes entered in medical record attestation sheet or discharge/</td>
</tr>
<tr>
<td></td>
<td>judged most related to event.</td>
<td></td>
<td>transfer or death summary. Indicate whether autopsy was performed, and record major</td>
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<td></td>
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<td>cause of death, using autopsy information or death certificate.</td>
</tr>
<tr>
<td>Data element</td>
<td>Definition</td>
<td>Priority</td>
<td>Directions or comments</td>
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</tr>
<tr>
<td><strong>Event variables</strong></td>
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<tr>
<td>Immediate precipitating cause</td>
<td>Immediate trigger for cardiorespiratory event.</td>
<td>Essential</td>
<td>Record as lethal arrhythmia, myocardial ischemia/infarction, hypotension, respiratory depression, metabolic, other, or unknown. The immediate trigger may be uncertain. Indicate yes or no (template boxes 2 and 3). If yes, list all of the following possibilities used: airway only, defibrillation only, or chest compressions only. If no, indicate whether patient was found dead; resuscitation attempt considered futile, or DNAR order existed.</td>
</tr>
<tr>
<td>Resuscitation attempted</td>
<td>Airway interventions, chest compressions, defibrillation, or DNAR status †</td>
<td>Essential</td>
<td></td>
</tr>
<tr>
<td>Initial resuscitation condition</td>
<td>Condition of patient at time of arrival of first healthcare professional.</td>
<td>Essential</td>
<td>Record yes or no for presence of apnea, pulselessness, and unconsciousness.</td>
</tr>
<tr>
<td>Initial rhythm</td>
<td>First monitored cardiac rhythm recorded after call for help.</td>
<td>Essential</td>
<td>Record as VT/VF, asystole, pulseless electrical activity, bradycardia, or normal perfusing rhythm (template boxes 5 and 6). Establish hospital-wide synchronization of clocks. Defibrillator clock can and should be standard synchronization clock for all interventions during resuscitation effort. For patients on telemetry, onset may be evident from telemetry monitor; however, resuscitation cannot begin until patient is physically located. Hence, this is the time to be recorded for audit purposes.</td>
</tr>
<tr>
<td>Method to time events and intervals</td>
<td>Audit forms should use 24-h clock time. An interval is the duration of time between timed events.</td>
<td>Essential</td>
<td></td>
</tr>
<tr>
<td>Time collapse noted</td>
<td>Time at which victim was seen or heard to collapse.</td>
<td>Essential</td>
<td></td>
</tr>
<tr>
<td>Time CPR team called</td>
<td>Time of call to hospital switchboard to mobilize cardiac event team.</td>
<td>Essential</td>
<td>A listing of all cardiac event calls should be kept by the hospital switchboard and audited against return of cardiac event report forms on a monthly basis. Does not apply in settings where specific event teams do not exist. In emergency departments, e.g., team is constantly present. Normally confirmed by first healthcare professional at the scene of the event. Record provider of first CPR for audit purposes. Record as nurse, clinical assistant, physician, respiratory therapist, or other. Most forms with resuscitation matrices allow space to record that CPR was stopped and started multiple times during 'stuttering' events. In Utstein style, multiple starting and stopping is unnecessary; report only final events. Newer defibrillators, especially shock advisory devices, possess event documentation capabilities that facilitate recording this information.</td>
</tr>
<tr>
<td>Time CPR team arrives</td>
<td>Time of arrival of personnel specifically responsible for performing resuscitation.</td>
<td>Essential</td>
<td></td>
</tr>
<tr>
<td>Time arrest confirmed</td>
<td>Best estimate of time of professional confirmation of absence of central pulse.</td>
<td>Essential</td>
<td></td>
</tr>
<tr>
<td>Time CPR started</td>
<td>Time of first chest compressions</td>
<td>Essential</td>
<td></td>
</tr>
<tr>
<td>Time CPR stopped</td>
<td>Time chest compressions stopped, not to be resumed; represents either time of death or time of ROSC.</td>
<td>Essential</td>
<td></td>
</tr>
<tr>
<td>Time of first defibrillatory shock</td>
<td>Time of first and all subsequent defibrillations should be recorded.</td>
<td>Essential</td>
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### Table 1 (continued)

<table>
<thead>
<tr>
<th>Data element</th>
<th>Definition</th>
<th>Priority</th>
<th>Directions or comments</th>
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</thead>
<tbody>
<tr>
<td>Time advanced airway achieved</td>
<td>Time of achievement of advanced airway management (not when first attempt is made).</td>
<td>Essential</td>
<td>Advanced airway management includes endotracheal intubation or alternative airway strategies (laryngeal mask airway or esophageal obturator airway)</td>
</tr>
<tr>
<td>Time of first IV dose of medication</td>
<td>Time of completion of administration of first dose of epinephrine, Essential adrenaline, or other medication.</td>
<td>Essential</td>
<td>The time, dose, and route of administration of all drugs should be recorded</td>
</tr>
<tr>
<td>Time of ROSC</td>
<td>Return of any palpable central pulse in the absence of ongoing chest compressions. When intra-arterial BP recording is present, a systolic BP ≥ 60 mm Hg is equivalent to a palpable central pulse.</td>
<td>Essential</td>
<td>Record time ROSC was achieved. Record as yes, never achieved, or achieved but not sustained (template box 9).</td>
</tr>
<tr>
<td>Time of end of ROSC</td>
<td>Applies to patients who have sustained ROSC or who died in hospital.</td>
<td>Essential</td>
<td>Categorize as never achieved, &lt; 20 min; &gt; 20 min but &lt; 24 h; or &gt; 24 h (template box 9).</td>
</tr>
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</table>

**Outcome variables**

<table>
<thead>
<tr>
<th>Data element</th>
<th>Definition</th>
<th>Priority</th>
<th>Directions or comments</th>
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<tbody>
<tr>
<td>Date and time of in-hospital death</td>
<td>Applies to patients with ROSC &gt; 24h.</td>
<td>Essential</td>
<td>Allows calculation of length of hospital stay and hospital survival after ROSC; not applicable for patients who survive to be discharged from hospital (template box 9).</td>
</tr>
<tr>
<td>Predeath status</td>
<td>After arrest, clinical status of patients who have ROSC may be reclassified.</td>
<td>Desirable</td>
<td>Record as not applicable (patient survived to discharge), full resuscitation status, changed to DNAR, support withdrawn after ROSC, declared brain dead, or referred for organ donation (template box 9).</td>
</tr>
<tr>
<td>Date and time of hospital discharge or transfer</td>
<td>Self-explanatory</td>
<td>Essential</td>
<td>Allows calculation of length of stay for successfully resuscitated patients. Record as not applicable (patients not resuscitated or died in hospital) or dd/mm/yr (template box 10).</td>
</tr>
<tr>
<td>Glasgow Coma Score</td>
<td></td>
<td>Essential</td>
<td>Record every 24 h after ROSC, at time of discharge until stable, at 6 mo and at 1 yr. For patients who die in hospital, record best achieved. Record separate scores for eye-opening response to speech and pain (1–4), verbal response to speech and pain (1–5), and motor response to voice commands and painful stimuli (1–6). Note that eye opening (3–4), verbal response (6), motor response (5) constitutes ‘awake’ (see time of awakening).</td>
</tr>
<tr>
<td>CPC</td>
<td></td>
<td>Essential</td>
<td>Record separate score for 5 components. Record at time of discharge, 6 mo, and 1 yr. For patients who die in hospital, record best CPC achieved. 0 = NA, not discharged alive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 = Good cerebral performance. Conscious, alert, able to work and lead a normal life. May have minor psychological or neurological deficits (mild dysphagia, hemiparesis, or minor CNS abnormalities).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 = Moderate cerebral disability. Conscious, sufficient cerebral function for part-time work in sheltered environment or independent activities of</td>
</tr>
<tr>
<td>Data element</td>
<td>Definition</td>
<td>Priority</td>
<td>Directions or comments</td>
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<tr>
<td>Time of awakening</td>
<td>Patient is considered awake if he or she responds appropriately to commands, makes spontaneous verbal statements, makes appropriate eye contact, makes appropriate motor responses, or appears conscious and oriented. Self-explanatory</td>
<td>Essential</td>
<td>daily life (e.g., dressing, traveling on public transportation, preparing food). May have hemiplegia, seizures, ataxia, dysarthria, dysphagia, or permanent memory or mental changes.</td>
</tr>
<tr>
<td>Alive at 6 mo, at 1 yr</td>
<td></td>
<td>Essential</td>
<td>3 = Severe cerebral disability. Conscious, dependent on others for daily support because of impaired brain function (i.e., lives in an institution or at home with exceptional family effort). At least limited cognition; includes a wide range of cerebral abnormalities from independent existence to paralytic and able to communicate minimally.</td>
</tr>
<tr>
<td>Date of death after hospital discharge</td>
<td>Applies to patients who are discharged alive from hospital.</td>
<td>Essential</td>
<td>4 = Comatose; vegetative state. Not conscious; unaware of surroundings; no cognition; no verbal or psychological interactions with environment.</td>
</tr>
<tr>
<td>Principle cause of death</td>
<td>Applies to patients who die after discharge</td>
<td>Essential</td>
<td>5 = Brain death/organ donation candidate. Record as interval, in hours, from arrest to awakening. An interval of 6–24 h may be used when awakening event is imprecise.</td>
</tr>
<tr>
<td>Immediate mechanism of death</td>
<td>Applies to patients who die after discharge</td>
<td>Essential</td>
<td>Record as yes (only if confirmed by reliable means), no, or unknown. Allows calculation of length of survival. Record as still alive, survival status unknown (dd/mm/yr) (template boxes 11 and 12).</td>
</tr>
<tr>
<td>Audit of resuscitation attempt</td>
<td>Self-explanatory.</td>
<td>Desirable</td>
<td>Add ICD-CM-9 codes when possible. Indicate source of information for cause of death (medical records, death certificate, autopsy, personal physician, or other) (template box 12).</td>
</tr>
</tbody>
</table>

ALS indicates advanced life support; BP, blood pressure; CHF, congestive heart failure; CNS, central nervous system; CPC, Cerebral Performance Category; CPR, cardiopulmonary resuscitation; CVA, cerebrovascular accident; DNAR, do not attempt resuscitation; ICD-9-CM, International Classification of Diseases, 9th ed; IV, intravenous; ROSC, return of spontaneous circulation; and VT/VF, ventricular tachycardia/ventricular fibrillation.

* See Fig. 5 for an example form incorporating these recommendations.
† A directive was entered into the medical record before the event stating that medical personnel should not attempt resuscitation.
Studies on the incidence of ventricular fibrillation (VF) in various age groups, for example, have yielded conflicting results. These differing results stem, in some degree, from whether to group adolescents with adults or children [48–52]. The context of the study determines the designation: adolescents may be included in pediatric studies provided they are separated from younger children or in adult studies provided they are separated from older adults. Because no single age is consistently used to separate children from adults, the following age categories and subsets (the convention is that the year of age advances on the exact anniversary of birth) are recommended:

- **Infant:** 0 to 12 months
  - 0 to 30 days
  - 31 days to 12 months

- **Child:** 1 to < 20 years
  - 1 to < 3 years
  - 3 to < 8 years
  - 8 to < 14 years
  - 14 to < 20 years

- **Adult:** 20 years and older
  - 20 to < 25 years
  - 25 to < 35 years
  - 35 to < 45 years
  - 45 to < 55 years
  - 55 to < 65 years
  - 65 to < 75 years
  - 75 to < 85 years
  - 85 and older

### 2.1.2. Gender

Researchers have paid increasing attention to the role of gender in cardiovascular disease in terms of risk factors, [53,54] outcomes, [53–59] and treatment differences [60–66]. The task force recommends recording the gender of all patients.

### 2.1.3. Witnessing and monitoring of event

Witnessed cardiac arrests are those that are seen, heard, or monitored. All witnessed arrests should be further classified as monitored (more often in intensive care units [ICUs] or telemetry units) or unmonitored (more frequently in locations that involve less critical care) because monitoring is likely to influence other patient variables. Patients whose cardiac arrests are not witnessed have markedly reduced chances of successful resuscitation and should be considered separately.

### 2.1.4. Location of event

In view of the differences in case mix and likely response interval in different areas of the hospital, documentation of the patient’s location at the time of cardiac arrest is considered an essential patient variable. Table 1 lists recommended location categories.

#### 2.1.5. Advanced life support interventions in place at time of arrest

Some resuscitation interventions are often instituted before a patient experiences an actual resuscitation emergency. For example, any of the following interventions may be in place when resuscitation begins: monitor and defibrillator, mechanical ventilation, intravenous pressor or inotropic agents, or intravenous antiarrhythmic agents. Survival rates for such a heterogeneous group of patients will likely be affected by the presence of these interventions as well as by the condition of the patients before the emergency. To illustrate, the outcome probability for VF arrest will likely differ markedly for a patient who is intubated and on a ventilator compared with a patient without special surveillance in a general ward. Table 1 describes a number of interventions that should be noted if present at the time of arrest.

#### 2.1.6. Previous cardiopulmonary arrest

Survival of a recent cardiac arrest constitutes a significant comorbid condition for future arrests and resuscitations. Recommendations on how to analyze patients who have had multiple arrests and have undergone previous resuscitations are discussed in the section on template box 9.

#### 2.1.7. Reason for admission

The task force recommends placing patients into several categories on the basis of the major reason for hospital admission (Table 1). These categories provide information on significant comorbid conditions that would otherwise confuse the results of resuscitation attempts. For example, patients hospitalized for medical reasons tend to have different causes of arrest and different resuscitation outcomes than patients admitted for surgery or out-of-hospital trauma.

#### 2.1.8. Prearrest functional capacity

Resuscitation outcomes can be evaluated only by comparing postresuscitation status with prearrest status [67]. A simple, validated tool for this purpose is lacking. The formal tools that can be used after the arrest are almost never applied before arrest. Furthermore, the optimal timing of the prearrest evaluation of function is unclear: should the level of function be recorded immediately before the arrest, at the time of admission, or at some time before admission?

The Glasgow-Pittsburgh outcome categories, including the Glasgow Coma Score, [68–70] the Cerebral Performance Categories (CPCs), and the Overall Performance Categories (OPCs) [71,72] are the most widely used tools to evaluate functional outcome following
resuscitation in adults. Numerous out-of-hospital studies have followed the recommendations of the Utstein style in this respect [73]. These categories were modified and validated for use in children [74]. They appear sufficiently broad so that the required information may be reliably derived from retrospective chart review, although this has not been confirmed. The task force recommends some attempt to record, through chart review or patient or family interview, the CPC and the OPC (using pediatric modifications if appropriate) at the time of hospital admission.

2.1.9. Comorbid conditions

Comorbid conditions have a powerful influence on the outcome of patients treated for out-of-hospital VF [75]. A comorbidity index derived from a medical history of 10 chronic conditions, medication use, and recent symptoms was strongly linked to survival [75]. Only one published study of in-hospital arrest patients considered these comorbid conditions [47]. Nevertheless, the task force recommends recording the presence of major comorbid conditions. The likelihood that these comorbid conditions will strongly influence resuscitation outcomes possesses a high degree of face validity. No single validated method exists to describe comorbidity in hospitalized patients. Although this is an important area for future research, the issue of comorbidity cannot be ignored while awaiting future studies. The task force recommends using the International Classification of Diseases, ninth edition (ICD-9-CM), to describe comorbid conditions. Because ICD-9-CM coding is completed only at discharge or death of the patient, care must be taken to include only the major ICD-9-CM codes present before the arrest.

The ICD-9-CM codes, however, have limitations. In many hospitals ICD-9-CM codes and discharge and diagnosis data (often collected for insurance purposes) are generated more to calculate hospital charges than to document patient diagnoses [76,77]. These codes consist of a heterogeneous group of conditions, including diagnoses, pathological processes, symptoms, physical findings, test findings, and severity indicators. The ‘correct’ coding may vary among providers, institutions, or regions. Researchers need some method to group ICD-9-CM codes to enable meaningful comparisons of outcomes between population subgroups. The BRESUS investigators used eight groupings of ICD-9-CM codes to classify a large number of ICD-9-CM codes [22]. This grouping may be useful, although others may be valid.

2.1.10. Severity estimates

The severity of a patient’s prearrest condition may certainly affect clinical outcome. No single, validated severity classification system is appropriate for both ICU and non-ICU patients. The Utstein Task Force considered a number of existing severity classification systems. The Acute Physiology and Chronic Health Evaluation (APACHE II or III) scoring system for patients in the ICU [78–80] is used in many critical care units, but it is complex and designed solely for ICU patients. Some research has addressed the problem of predicting failure to survive after in-hospital CPR [41,81–84]. The Pre-Arrest Morbidity (PAM) Score includes comorbidity factors but has been validated only as an instrument to predict outcome following cardiac arrest [83,85]. The Prognosis-After-Resuscitation (PAR) Score has fewer variables than the PAM score and in Ireland was better at predicting patients unable to survive in-hospital resuscitation [84]. The Therapeutic Intervention Scoring System (TISS) [86,87] and the modified TISS (for non-ICU patients) are limited because they reflect more the therapy provided than the severity of the patient’s illness. The various revisions of the New York Heart Association functional classification are too nonspecific and broad [88]. At this time the task force recommends use of the most appropriate validated severity classification system for the population studied.

Other arrest data, including location (ICU versus ward) and concurrent therapeutic interventions (e.g., mechanical ventilation or administration of vasopressors) (see below) may provide some surrogate information to suggest the severity of illness. Research is necessary to establish whether these proxy measures are valid surrogates for classification of severity.

2.1.11. Race/ethnicity

Several research projects have identified a powerful association between race and the incidence of bystander CPR, [89] outcomes of cardiovascular disease, [90–92] survival of out-of-hospital sudden cardiac arrest, [93,94] and survival following in-hospital CPR [95]. The outcome of resuscitation attempts for some ethnic groups may be influenced by additional factors such as socioeconomic status, [96,97] inequalities in access to health care, utilization of health care, or provision of health care.

The task force recognized major differences in the categories for expressing race among countries. The racial mix of patients in different countries varies significantly, and no common list of racial categories that applies to all countries can be specified. Any group accounting for only a small proportion of a study population will seldom produce data that can be analyzed meaningfully. The task force therefore recommends that researchers specify only those minorities or ethnic groups that make up a significant proportion of the total population of a study.

2.1.12. Socioeconomic status

Some researchers have found an association between lower socioeconomic status and lower rates of survival
of out-of-hospital cardiac arrest [97,98]. Researchers have used a variety of measures of socioeconomic class in other epidemiological research, none of which are internationally accepted. The task force does not recommend a single measure of socioeconomic status to collect but considers this an interesting area for future research.

2.2. Event variables

The major event variables that should be recorded are rhythms, interventions performed, event times, and event intervals.

2.2.1. Rhythms

The task force recommends grouping arrest rhythms into two major categories: VF/pulseless ventricular tachycardia (VF/VT) or non-VF/VT [15,16]. Non-VF/VT can be subclassified as either pulseless electrical activity (PEA) or asystole. These rhythms are defined in template boxes 7 and 8.

2.2.2. Interventions

Essential interventions that should always be recorded if performed include the following:
- Defibrillation
- Insertion of an artificial airway, specified by type (e.g., endotracheal tube or laryngeal mask)
- Drugs, including antiarrhythmic agents and vasoressors
- Pacing, specified by type (e.g., external or internal)
- Mechanical circulatory assist devices (e.g., balloon pump or cardiopulmonary bypass).

2.2.3. Event times and event intervals

Table 1 provides definitions and directions for the recommended variables. All of the following event times are essential and should be recorded if relevant and available:
- Time of collapse (event onset)
- Time of call for help
- Time of arrival of CPR team
- Time of confirmed cardiac arrest
- Time CPR started
- Time CPR stopped
- Time of first defibrillatory shock (and all subsequent shocks)
- Time of advanced airway management (including intubation)
- Time of first dose of intravenous epinephrine/adrenaline and all other resuscitation medications
- Time of any return of spontaneous circulation (ROSC) and of sustained ROSC
- Time of end of ROSC
- Time of abandonment of resuscitation attempt

Lack of clock accuracy and synchronization can be a major problem in resuscitation research [99–101]. Hospitals should synchronize the clocks used in resuscitation records to a single time source. Current defibrillator models provide time annotations on monitor strips; therefore, the defibrillator is the best source for clock synchronization.

From the recorded event times a variety of intervals (time elapsed between two events) can be calculated. The following intervals are recommended as the gold standard process variables for interhospital and intra-hospital comparisons:
- Interval from event onset to start of CPR
- Interval from event onset to first defibrillation
- Interval from event onset to advanced airway management
- Interval from event onset to first administration of resuscitation medication

Other clinically important intervals include the following:
- Interval from event onset to ROSC (palpable spontaneous pulse)
- Interval of sustained ROSC
- Interval from event onset to CPR stopped

2.3. Outcome variables

Resuscitation aims to return patients to their level of health before the cardiac arrest. Resuscitation outcome can be expressed in one or more of three domains: survival (did the patient live?), longevity (how long did the patient live?), [70,102,103] and quality of life (how well did the patient live?) [104–106]. Survival can be subdivided further using a time dimension, such as immediate (ROSC), short-term (discharged alive from the hospital), or long term (6 to 12 months).

2.3.1. Quality of life as an outcome

Quality-of-life outcomes reflect the widely accepted concept that health is not just the absence of disease and infirmity but also the presence of physical, mental, and social well-being [107]. Assessment of quality of life as an outcome requires reference to physical, psychological, and social domains of health. These domains are measured as either objective assessments of functioning or as subjective perceptions. The rich interaction of objective functioning and subjective perceptions determine the overall quality of life for an individual. Two people with the same results on objective measures of health may have profoundly different estimates of quality of life.

2.3.2. Functional outcomes

Although many valid functional assessment instruments have been developed, no single approach applies to all patients. The Glasgow Coma Score, introduced and validated for neurological assessment following
trauma, is a simple-to-record, reproducible assessment of consciousness [70]. The three individual components of the 15-point score (motor response, verbal response, and eye opening) are recorded separately, then in total, 24 h after the initial event. The motor component is best associated with outcome, particularly if the score is recorded daily over time [108,109]. Recording of brain stem reflexes may add additional predictive value [110].

The CPC score is one of several instruments developed to assess cerebral performance outcomes following both traumatic and anoxic cerebral injuries [71,72]. This score approaches a disease-specific instrument because survival of cardiac arrest constitutes survival of a transient, global cerebral ischemic or anoxic event. The CPC score has been used to evaluate outcomes in several studies of cardiac arrest survivors [105,111–115]. However, its use as a single measure of neurological outcomes in cardiac arrest survivors has been strongly criticized [116]. Hsu et al. [116] noted that in a small group (n = 35) of cardiac arrest survivors, the CPC score correlated poorly with subjective quality-of-life assessments and results of validated objective functional testing instruments. An additional useful measure of minimum neurological outcome is the time to awakening or return of consciousness [117].

As minimum uniform assessments, the task force recommends recording the time to awakening and the serial Glasgow Coma Scores in the immediate postarrest period. These measures will document either return of consciousness or persistence of various levels of the coma state. In addition, the CPC should be recorded at hospital discharge and again 6 months to 1 year after the event. The Utstein Task Force recognizes the limitations of the CPC score and that use of multiple standardized testing instruments is superior. [106,118] The CPC score has the appeal of simplicity and practicality.

For patients who die between hospital discharge and 1 year after the arrest, the best functional status during that year should be recorded if it is available and practical to obtain. Recording the best functional status is recommended because a subsequent decline in functional outcome after initial improvement may be unrelated to the arrest. For example, premorbid conditions may affect eventual outcomes more than the arrest episode itself.

2.3.3. Additional outcome assessments

Length of stay (days of hospitalization) after resuscitation is a useful variable to record. Length of stay can help answer questions about the value of in-hospital resuscitation because a number of studies have documented prolonged hospital stays after resuscitation [114,119,120]. Patients may be resuscitated from a cardiac arrest but condemned to live many weeks in a severely compromised state, requiring costly intensive care. Serious cost-benefit concerns arise when compromised patients die after prolonged hospital stays, not to mention the pain and suffering experienced by the patient and family members.

Cost data have not been included in many publications on resuscitation [114,121,122]. The cost-effectiveness of interventions such as CPR and resuscitation, however, must be evaluated. Investigators should measure costs rather than charges because costs better represent the societal burden of an intervention such as CPR [123]. The cost benefit of in-hospital resuscitation may be expressed as the cost per survivor to hospital discharge or the cost per quality-adjusted life-year. Calculation of total costs includes the costs of resuscitation, stay in the ICU, stay in the ward, and subsequent nursing home or home health costs. An increase in survival rates will result in lower costs per survivor. The value of this information may be severely limited by economic factors such as inflation, profitability issues, cost shifting, reimbursement policies, and variable national approaches to healthcare financing.

If the patient is discharged, researchers may record the discharge destination: home (or prevegetation), rehabilitation facility, extended-care facility (nursing home), another acute care hospital, or other. Although discharge destination is often used as a surrogate for neurological outcome, researchers should record the need for home nursing care because discharge to home may not necessarily represent a good outcome.

2.4. Hospital variables

Hospital variables are required for interhospital comparisons because the setting of an arrest influences resuscitation capabilities and outcome data. However, no widely accepted categorization of hospital variables exists. Many variables are independent factors that may affect outcome. Table 2 provides a checklist of information to include on reports of in-hospital resuscitation. The task force declined to recommend any of these variables as essential because the effect of any of these on arrest outcomes is speculative. Additional research and publications will provide better guidance.

3. Utstein template for reporting data from in-hospital resuscitation

3.1. Template concept: what it represents, how to use it

The Utstein style was created for reporting out-of-hospital cardiac arrest [24,30]. The centerpiece of that work was a template for uniform display of outcomes. This template, although now used widely, is not always used correctly. The template concept is based on the following principles:
Table 2
Checklist of information to include in reports on in-hospital resuscitation

<table>
<thead>
<tr>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Care level of hospital (primary, secondary, or tertiary)</td>
</tr>
<tr>
<td>• Total number of hospital beds</td>
</tr>
<tr>
<td>• Total beds allocated to</td>
</tr>
<tr>
<td>— Intensive care units, coronary care units</td>
</tr>
<tr>
<td>— General or ward</td>
</tr>
<tr>
<td>— Emergency department</td>
</tr>
<tr>
<td>• Annual number of admissions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resuscitation management</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Describe general treatment approach (whether by immediately available personnel or by designated cardiac arrest responders)</td>
</tr>
<tr>
<td>• State response origin (whether on-site or from location distant from arrest)</td>
</tr>
<tr>
<td>• Describe composition of arrest team, both professional level and treatment capabilities (e.g., can nurses perform defibrillation or endotracheal intubation?)</td>
</tr>
<tr>
<td>• Describe method for activating arrest response (whether by general broadcast public alert or local audio alert, alerting device carried by response team members)</td>
</tr>
<tr>
<td>• List equipment usually available (defibrillators [conventional, automated, or both], endotracheal intubation apparatus, intravenous medications, other)</td>
</tr>
<tr>
<td>• Describe type of resuscitation training for response personnel (ACLS training, BLS, defibrillation)</td>
</tr>
<tr>
<td>• Describe types of treatments and treatment protocols (eg, are they consistent with AHA/ERC guidelines?)</td>
</tr>
<tr>
<td>• List average number of resuscitations attempted per year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gold standard process intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Record median response intervals from onset of emergency to start of basic CPR</td>
</tr>
<tr>
<td>• Record interval from collapse to first defibrillatory shock for patients in VF</td>
</tr>
<tr>
<td>• Record interval from collapse to endotracheal intubation</td>
</tr>
<tr>
<td>• Record interval from collapse to first intravenous administration of epinephrine</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resuscitation outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provide data to allow calculation of the following survival rates*</td>
</tr>
<tr>
<td>— Percent survival from arrest to successful resuscitation (ROSC &gt; 24 h)</td>
</tr>
<tr>
<td>— Percent survival from successful resuscitation (ROSC &gt; 24 h) to discharge</td>
</tr>
<tr>
<td>— Percent survival from successful resuscitation (ROSC &gt; 24 h) to 1 yr</td>
</tr>
<tr>
<td>— Percent survival from arrest to discharge</td>
</tr>
<tr>
<td>— Percent survival from discharge to 1 yr</td>
</tr>
<tr>
<td>— Percent survival from arrest to 1 yr</td>
</tr>
<tr>
<td>• For each survivor alive at 1 yr, determine</td>
</tr>
<tr>
<td>— Number of attempted resuscitations</td>
</tr>
<tr>
<td>— Number of initial survivors (ROSC &gt; 20 min)</td>
</tr>
<tr>
<td>— Number surviving first 24 h</td>
</tr>
<tr>
<td>— Number leaving hospital alive</td>
</tr>
<tr>
<td>• To adjust for readmits and rearrests, calculate</td>
</tr>
<tr>
<td>— Percent survival from arrest to discharge per patient with ≥1 arrest</td>
</tr>
<tr>
<td>— Percent survival from arrest to discharge per total resuscitation attempts</td>
</tr>
<tr>
<td>— Percent successful resuscitations (ROSC &gt; 24 h) per total resuscitation attempts</td>
</tr>
<tr>
<td>• For patients who have ROSC &gt; 24 h, report</td>
</tr>
<tr>
<td>— Median length of hospital stay</td>
</tr>
<tr>
<td>— Median cost and charges (distinctions between hospital costs and patient charges should be appreciated, and clarifying statements provided in report)</td>
</tr>
<tr>
<td>— Destination of discharged patients (home, minimal to highly skilled nursing facility, custodial care facility, other)</td>
</tr>
<tr>
<td>• For patients who had any ROSC but died in hospital, report</td>
</tr>
<tr>
<td>— Percent declared DNAR</td>
</tr>
<tr>
<td>— Percent who had support withdrawn</td>
</tr>
<tr>
<td>— Percent who had brain death established</td>
</tr>
<tr>
<td>— Percent who had organ donor status declared</td>
</tr>
<tr>
<td>• For patients discharged from hospital, report</td>
</tr>
<tr>
<td>— Distribution of survivors within CPCs (percent in level 1, level 2, etc)</td>
</tr>
<tr>
<td>— CPCs for survivors who live ≥ 6 mo</td>
</tr>
<tr>
<td>— CPCs for survivors who live ≥ 1 yr</td>
</tr>
<tr>
<td>• Time trends</td>
</tr>
<tr>
<td>— Record outcomes listed above on an annual basis and compare changes over time</td>
</tr>
</tbody>
</table>

Ethical considerations

• DNAR status (describe hospital’s DNAR policy, eg, are advance directives discussed at admission? who determines DNAR? how are patient wishes identified? can physicians declare DNAR status on the basis of medical futility alone without discussing with patients, family members, or surrogates?) |
| • Informed consent (describe how informed consent is obtained when resuscitation research protocols exist, eg, are protocols submitted to an institutional review board?) |
| • Patient confidentiality (describe how patient confidentiality is preserved in reviews of in-hospital research outcomes, particularly measurement of postresuscitation functional status) |
| • Organ donation (when relevant, describe hospital policy on resuscitation for organ donation) |

• Practicing procedures on the newly dead (report whether hospital personnel are allowed to practice resuscitation procedures on the newly dead; if so, describe hospital policy and whether consent is obtained from relatives) |

• Presence of relatives during resuscitation attempt (report whether this practice is allowed and it is handled) |

ACLS indicates advanced cardiac life support; AHA, American Heart Association; BLS, basic life support; CPC, Cerebral Performance Category; CPR, cardiopulmonary resuscitation; DNAR, do not attempt resuscitation; ERC, European Resuscitation Council; ROSC, return of spontaneous circulation; and VF, ventricular fibrillation.

* Absolute numbers used to calculate percentages should be provided.

The initial boxes of the template define a population; this population must be accounted for in subsequent boxes of the template.

The number of each box serves both as the numerator for the box above it and as the denominator for the box below it.

The template displays a central ‘trunk,’ which is considered the most important subpopulation to report.

Depending on the objectives of the study, several branches can be identified and analyzed, analogous to a hierarchical filing system or pull-down menus in the organization of computer files.

Although numerous branches of the algorithm can be developed, in most instances this is not necessary.

Concerns about sample size will necessitate combining rather than splitting population subsets. Investigators should make clear which subsets are
being considered and which have been combined or subdivided.

3.2. Template boxes (Fig. 2)

3.2.1. Template box 1: in-hospital patients with a pulse

This template box provides the conceptual starting point to analyze resuscitation results obtained in a hospital. Researchers do not need to determine this exact number because it is not required for later outcome calculations. This population is analogous to the 'population served' in out-of-hospital statistics [24,30]. Any patient arriving at the hospital with a spontaneous pulse becomes a candidate for later resuscitation attempts. Include all patients who occupy a hospital bed. No minimum stay, such as more than 24 h, is recommended. Include patients who experience an arrest in the emergency department or casualty suite.

Exclude from analysis (or report as separate subsets if these patients represent an area of particular interest) persons brought to the hospital for pronouncement of death and persons who do not occupy a bed, such as outpatients or clinic attendees who suffer a cardiac arrest inside the hospital. Finally, report separately persons who originally had an arrest outside the hospital and were brought to the emergency department after ROSC or with continuing CPR. These patients more properly belong in the original out-of-hospital template.

3.2.2. Template box 2: cardiac arrest, no resuscitation attempted

- Patients designated as DNAR
- Patients not designated as DNAR
  - Found dead
  - Considered futile

Some patients, for reasons of self-determination, living wills, advance directives, or medical indications, should not receive attempted resuscitation. Most hospitals have mechanisms to identify these patients. These patients do not belong in a denominator for calculating in-hospital survival rates and should be separated from the main branch of the template.

The task force endorses use of the term 'do not attempt resuscitation' (DNAR). It is inappropriate and misleading to use a term such as 'do not resuscitate,' which implies to patients, family, and friends that personnel could have resuscitated a patient if they had wished. The term DNAR offers a more accurate assessment of the reality of resuscitation attempts [124].

It is recognized that there will be additional patients for whom no resuscitation attempts will be made. The two major groups are patients found dead in bed or elsewhere in the hospital and patients for whom the response teams, for a variety of reasons, considered resuscitation efforts futile.

3.2.3. Template box 3: attempted in-hospital resuscitations

- Total
  - Defibrillation only
  - Chest compressions only
  - Airway interventions only
  - Combination interventions

Any meaningful resuscitation attempt by appropriate healthcare providers qualifies as attempted in-hospital resuscitation (template box 3). Stopping resuscitation efforts because the patient failed to respond to initial ACLS efforts represents an attempted resuscitation. If rescuers inadvertently provided a full resuscitation attempt to a DNAR patient, this is an attempt. If only a momentary attempt was made while personnel confirmed the DNAR status or because of immediate discovery or determination that resuscitation is not indicated, the 'no resuscitation attempted' classification should be selected.

The task force discussed a single, easily recognized criterion to define a resuscitation attempt. Published work suggests that 'chest compressions started' would provide an unambiguous criterion [125]. In addition, chest compressions started is consistent with the out-of-hospital Utstein nomenclature for the denominator starting point [24,30]. The disadvantage of the chest compression started criterion, however, is that it excludes many patients who do not require chest compressions because personnel resuscitate them by defibrillation or airway interventions only. For example, patients with monitored pulseless VT or VF may be treated successfully by immediate defibrillation. This action would obviate the need for chest compressions.

Respiratory compromise and deterioration, especially in children, could lead to bradycardia, hypotension, asystole, and full cardiac arrest [126]. Timely airway interventions, however, can prevent this sequence. To measure the full range of resuscitation success for in-hospital resuscitation, the Utstein task force defines a resuscitation attempt as any effort to restore effective ventilation, oxygenation, and circulation to a patient by the use of any or all of the following methods: defibrillation, cardiac pacing, chest compressions, airway interventions, or intravenous medications. These efforts should be included as subsets in template box 3.

Which patients should be moved farther down the main trunk of the template? Some investigators suggest that the majority of patients who should be moved below box 3 will require combination interventions and are in complete cardiac arrest. The definition of complete in-hospital cardiac arrest is based on the defini-
Fig. 2. In-hospital Utstein-style template. ALS indicates advanced life support; BLS, basic life support; DNAR, do not attempt resuscitation; ED, emergency department; out-pts, out-patients; PEA, pulseless electrical activity; pts, patients; ROSC, return of spontaneous circulation; and VF/VT, ventricular fibrillation/ventricular tachycardia.
tion recommended for out-of-hospital arrest: absence of a palpable pulse and initiation of chest compressions [24,30]. All signs of cardiac arrest, however, such as unresponsiveness and apnea, may not be relevant in all hospital patients. Sedation or anesthesia-induced apnea during artificial ventilation may eliminate the criterion of unresponsiveness. Therefore, the following definition of complete cardiac arrest is recommended:

- Absence of a palpable pulse
- Unresponsiveness due to any cause
- Apnea, agonal respiratory attempts, or artificial ventilation

3.2.4. Template box 4: false arrests

- BLS or ALS actions not needed

Box 4 provides a place to record false arrests or activations of a resuscitation response for an event that does not represent a true cardiopulmonary emergency. Many events, such as vasovagal episodes, fakets, seizures, calls for security help, or a variety of other calls, may precipitate an in-hospital emergency response. Personnel often complete an emergency response form or in-hospital audit form for these events. Several researchers, however, have argued for the need to avoid using near-arrests, false arrests, or response team activations to calculate outcome rates [125,127,128]. Although these events document the activity of a hospital’s emergency response team, such events should not be used to compare outcomes between hospitals.

3.2.5. Template box 5: non-VF/VT

- Asystole
- PEA

Asystole is defined as complete electrical silence, that is, no cardiac electrical activity can be detected with body-surface electrodes. Electrical activity that is < 1 mm in amplitude (at a calibration of 10 mm/mV) should be classified as asystole. The rate division between asystole and PEA (see below) is not well defined. A pulseless rate < 10 beats per minute (bpm) was selected as the definition of asystole, but this is an arbitrary figure. So-called ‘P-wave asystole’ was discussed as a possible subset of asystole that should be identified and treated specifically, for example, with cardiac pacing. The task force, however, could reach no consensus on this entity and whether it should be treated differently from asystole without P waves [129]. In-hospital patients with asystole may have a prognosis different from that of out-of-hospital patients with asystole [130] because in-hospital asystolic patients have a shorter duration of asystole.

PEA is any other non-VF/VT pulseless rhythm apart from asystole. A variety of subcategories of PEA are possible. Narrow complex PEA is thought to have a better prognosis than wide-complex PEA, especially if the PEA rate is rapid (suggesting, e.g., hypovolemia). PEA with a slow rate may respond to cardiac pacing. The value of subdividing patients into such categories is unclear, and no specific recommendations were developed [131].

3.2.6. Template box 6: initial rhythm VF/VT

VF is defined as disorganized, irregular electrical activity that produces no appreciable cardiac pumping action. The dividing point between asystole that should not be shocked and ‘fine VF’ that should be shocked remains controversial. Utstein I defined VF as starting when the peak-to-trough deflections on the surface electrocardiogram are > 1 mm in amplitude (at a calibration of 10 mm/mV) and faster than 150 bpm [24].

Studies have shown that a lower percentage of victims of in-hospital cardiac arrest are in VF compared with out-of-hospital patients. Nevertheless, VF is the ‘rhythm of survival’ for most cardiac arrest patients, both in hospital as well as out of hospital. Rapid identification of patients who are in VF must remain a major objective of all resuscitation attempts.

With box 6 the template has arrived at the index point for all subsequent outcome results. Boxes 1 through 4 present important data for setting the context of outcome results. Although a variety of outcome rates can be calculated using the numbers in boxes 1 through 4 as denominators, the task force recommends that box 6 serve as the parent denominator for uniform reporting of adult in-hospital arrests. As discussed below, there are several recommended survival rates for inter-hospital comparisons. Process gold standards (e.g., intervention intervals), however, may prove to be more useful in light of the complicating elements of frequent comorbid conditions and varying levels of severity.

3.2.7. Template box 7: never achieved ROSC

Box 7 displays the true failures of in-hospital resuscitation, that is, patients who do not respond to resuscitation efforts with even a brief ROSC.

3.2.8. Template box 8: any ROSC

In the out-of-hospital Utstein style, any return of a spontaneous pulse, detectable by palpation of a central artery (carotid or femoral), is considered ROSC; no minimal duration for spontaneous circulation is required [24]. This recommendation intends to capture any possible promising therapy or intervention, even though a few minimally palpable pulses cannot be considered return of ‘spontaneous circulation’. Intermittent ROSC refers to patients who have brief periods of ROSC but who require CPR between these episodes. Sustained ROSC is defined as the single, continuous presence of palpable pulses for more than 20 min.
ROSC lasting longer than 20 min may also be used to define when one CPR attempt ends and a new episode begins.

Arrest may occur in a patient who already has invasive hemodynamic monitoring devices in place. Cardiac output may be detected by techniques such as intravascular pressure monitoring, transesophageal or thoracic echocardiography, or Doppler pulse detection. In these patients, detectable cardiac output should be recorded, even when a pulse is not palpable. Detectable cardiac output without a palpable pulse ('pseudo-electromechanical dissociation') may be associated with improved outcome [132].

3.2.9. Template box 9: died in hospital

- ROSC $\leq$ 20 min
- ROSC $> 20$ min but $\leq$ 24 h
- ROSC $> 24$ h

Box 9 is for recording patients who are successfully resuscitated but who do not survive to hospital discharge. The task force recommends three categories of ROSC, each one indicating a longer duration of sustained, spontaneous circulation: $\leq$ 20 min, $> 20$ min but $\leq$ 24 h, and $> 24$ h. The $\leq$ 20-min category is for patients who are briefly resuscitated; they may experience only a few seconds of detectable cardiac output. Resuscitation in such patients cannot be called successful. Patients who live at least 24 h (ROSC $> 24$ h) are considered successfully resuscitated (see below) even if they do not survive to discharge. Patients with ROSC $> 20$ min but $\leq$ 24 h are an intermediate category. Box 9 was included in the template to attach greater meaning to sustained ROSC. Early death in the first day most often occurs as a result of continuing cardiovascular compromise in patients who never regain consciousness after CPR [117].

- Restart/reattents/rearrests

Template box 9 also presents a means for handling the complicated problem of analyzing patients with multiple arrests during the same hospitalization. If every attempted resuscitation is reported as a separate event, rates of successful resuscitation will be inflated, and rates of survival to hospital discharge will be reduced. This poses the methodological questions of whether the denominator for outcome measurements should be reported per patient or per attempted resuscitation and whether the numerator should be successful resuscitation (ROSC $> 24$ h) or successful discharge. The following example illustrates this problem.

Two patients experience in-hospital cardiac arrest. The first patient arrests, is successfully resuscitated, and is discharged alive. The second patient has a stormy course, arresting 10 times during a prolonged hospitalization. Personnel cannot resuscitate this patient during the tenth arrest, and the patient dies. The following outcome rates can be calculated:

<table>
<thead>
<tr>
<th>Numerator/denominator</th>
<th>Outcome rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients discharged alive/patients with one or more arrests</td>
<td>1 of 2 (50%)</td>
</tr>
<tr>
<td>Patients discharged alive/resuscitation attempts</td>
<td>1 of 10 (10%)</td>
</tr>
<tr>
<td>Successful resuscitations/resuscitation attempts</td>
<td>9 of 10 (90%)</td>
</tr>
</tbody>
</table>

The task force recommends that all three outcome rates be available. Because some hospitals will have only a small number of patients in these categories, calculation of all possible rates or percentages may fail to adequately express the clinical variability that exists. Confidence intervals improve interpretation of the study data by indicating the degree of uncertainty about an observation. Recent resuscitation research provides a useful illustration of the use of confidence intervals to express outcome data [133].

Identify the number of patients in whom

- DNAR status was declared
- Support was withdrawn
- Brain death was established
- Organ donor status was declared

Physicians may treat patients several different ways after a successful resuscitation. Some patients may be given maximum therapy in a concerted effort to help the patient survive to hospital discharge. Alternatively, physicians may, in consultation with family members, reevaluate survivors after the first in-hospital arrest and place these patients in other management categories, which include declaring the patient brain dead or DNAR, withdrawing ventilatory and pharmacological support, and considering whether the resuscitated patient would be a suitable organ donor. Subsequent cardiac arrests in these patients may be 'unresisted,' as suggested by Longstreth and Dikmen [67]. The management of these survivors of an initial cardiac arrest can profoundly change in-hospital survival rates.

Identification of patients for whom support is limited or withdrawn will help answer an important question: Are some differences in survival between centers related to different approaches to the care of patients with severe compromise after resuscitation? From an epidemiological perspective, these patients are eliminated from the survivor numerator. Their failure to survive would adversely reflect on the resuscitation success of the hospital. Because these patients are removed from any possibility of surviving the index car-
3.2.10. Template box 10: discharged alive
   Total
   • Alive at 6 months
   • Alive at 1 year
   The most frequently used outcome measure for cardiac resuscitation is the rate of survival to hospital discharge. The numerator for this rate is the number of patients discharged from the hospital with spontaneous circulation and ventilation. The task force recommends notation of the number discharged alive, the number alive at 6 months, and the number alive at 1 year.

   Unique discharges, such as patients with brain death transferred to another hospital for organ donation, should be reported separately. Such patients do not represent a successful resuscitation. A variety of discharge destinations are possible, ranging from preadmission residence to intensive care custodial facilities. Patients transferred to another hospital for further diagnostic or therapeutic procedures are listed as discharged alive for the hospital where the cardiac arrest occurred. Accounting for these patients, if they die in the recipient hospital, will occur when length-of-survival and functional outcomes are determined (template boxes 11 and 12).

   Patients may occasionally be discharged with a spontaneous pulse and respirations yet require intravenous medications such as vasopressors, antiarrhythmics, and cardiac inotropes, or intermittent advanced ventilatory support. Whether such patients merit reporting as successful survivors of in-hospital cardiac arrest is debatable. Common sense is needed. Exceptional patients may fall so far outside the usual definitions that they will need to be reported separately.

3.2.11. Template box 11: died within 1 year of discharge

3.2.12. Template box 12: alive at 1 year
   Once a patient is discharged alive from the hospital, outcome auditing requires date of death (if death occurs during the first year after discharge) or confirmation that the patient is alive after 1 year. These data do not flow routinely into the hospital where the index arrest occurred. Researchers must therefore establish an additional data collection system, such as telephone calls and surveillance letters; postcards and questionnaires to care facilities, patients, relatives, and physicians; death certificate review; and periodic home visits. The key, according to researchers who have published the best data on length of survival, is a single, dedicated research associate who establishes a close relationship with the survivors and their families and contacts them at regular intervals [105,134]. In the United Kingdom, the Office of Population and Census prospectively tracks people who meet specified criteria (e.g., survivor of cardiac arrest) and notifies researchers of the date and certified cause of death when death occurs.

   Problems arise when patients are transferred (from hospital to nursing facility to home and back again); when patients or their families change hospitals and physicians; when patients relocate (to other addresses, cities, even states and countries); when telephone calls or surveillance letters are not returned; and when there is a lack of cooperation among the physician, patient, and family [130,135].

   The date of death for arrest survivors who die after discharge should be available through death certificates. Gaining access to and tracking death certificate data may be a problem in some regions, states, and countries. In the United States, social security numbers are the indexing codes used in most death-certification programs. This number, however, is often not recorded in hospital records or is not available to researchers because of patient confidentiality concerns.

   The survival data can be presented in several valid ways. A simple percentage (number alive at 1 year over number discharged alive from the hospital) is the most straightforward calculation. However, survivors to hospital discharge are not released at one point in time; a hospital's successful discharges are staggered over many weeks and months. Therefore, by definition, all survival-to-1-year data will be 1 year out of date because allowance must be made for the last individual discharged alive to have a chance to live 1 year.

   Most survival studies solve this problem by using some method of calculating probability of survival to 1 year. These probabilities then must be adjusted for attrition, death, relocation and transfer, inability to follow up, loss to follow-up after enrollment, lack of information, or lack of cooperation. Newly discharged alive patients enter the study survivors group upon discharge. They remain in that group until 'removed' from the cohort by one of the events noted above (death, loss to follow-up, etc). Kaplan-Meier survival curves are the most widely used statistical means for presenting these data. (For more detailed information, refer to Kaplan and Meier [136].)

   Another recommended statistical approach to expressing survival is a modification of the life-table method adopted by the United Kingdom Resuscitation Council in BRESUS [22]. In that study survival was viewed from two perspectives. First, beginning at the time of the arrest, investigators determined how many people would live through subsequent time periods. Survival results can be reported from either single or overlapping periods. For example, the BRESUS investigators observed the following survival rates: 71.7% from the arrest to 24 h, 62.7% from 24 h to discharge, 71.8% from discharge to 1 year, 32.4% from 24 h to 1 year, and 12.5% from arrest to 1 year [22].
the second approach, the BRESUS investigators asked how many attempted resuscitations are required to produce one survivor at 1 year. The results demonstrated that for every 1-year survivor there were 8 attempted resuscitations, 3 initial survivors, 2 who survived the first 24 h, and 1.5 who left the hospital alive [22].

The Utstein Task Force recognizes the need to establish a body of published survival rates of in-hospital cardiac arrest that use comparable definitions of survival. Because the BRESUS report is the largest existing report of in-hospital survival rates, it is advantageous for other projects to use the BRESUS definitions. The Utstein Task Force therefore recommends that researchers use the data from template boxes 9 through 12, combined with the life-table method to allow for losses to follow-up, [22] to calculate the following survival rates:

- Percent survival from the arrest to at least 24 h (ROSC > 24 h)
- Percent survival from successful resuscitation (ROSC > 24 h) to 1 year
- Percent survival from arrest to discharge
- Percent survival from discharge to 1 year
- Percent survival from arrest to 1 year

For each survivor alive at 1 year, calculate the following:

- Number of attempted resuscitations
- Number of initial survivors
- Number surviving first 24 h
- Number leaving the hospital alive

3.2.13. Template box 13: functional outcomes

The functional outcome (neurological and psychological status) should be measured at the following times:

- Hospital discharge
- 6 months to 1 year

The dashed line to box 13 indicates that assessment of outcome is completed only by providing a measure of functional outcome. Ideally, researchers should record the best neurological and psychological status achieved after resuscitation. Research, however, has not established the best measures of quality-of-life or functional outcomes after cardiac arrest [105,106,116,130,131]. The optimal time intervals for performing functional assessments are unknown [118]. The task force recommends, as a minimum, assessment of functional outcome near the time of hospital discharge and again at 6 months to 1 year. Practical concerns support general use of the CPC score, whereas for more focused research projects additional measures are needed [116]. Some research suggests that patients reach their maximum level of recovery from the original anoxic or ischemic event of the cardiac arrest between 6 and 12 months [118]. After that point, patients begin to experience mortality and morbidity because of age and preexisting illnesses [106].

4. Data to collect on individual patients

Table 1 lists the data on individual patients that the task force recommends be collected. These data will support analyses for intrahospital audits and interhospital comparisons and will allow completion of the in-hospital Utstein-style template (Fig. 2). This approach was pioneered in the first Utstein-style guidelines for reporting out-of-hospital cardiac arrest [24,30]. However, the task force acknowledges a conceptual debt to the uniform data sets designed by Spaite et al. [137] for the National Highway Traffic Safety Council.

Unfortunately, no single cardiac arrest audit form can capture all the recommended data. The primary problem emanates from the methodological challenge of data synchronization. This problem is illustrated in Fig. 3, which demonstrates that researchers can gather complete resuscitation data about an individual only by moving back and forth in time.

An individual patient first becomes of interest for data collection when he or she suffers an in-hospital cardiopulmonary emergency. At the time of the resuscitation attempt, personnel record only immediate hospital and patient data about the resuscitation (e.g., time of defibrillation). Immediately after resuscitation, patient variables can be gathered by reviewing the patient's hospital records. Outcome data (e.g., date of death) can be collected by a prospective surveillance system, but this requires linking the clinical information with the surveillance system. Prospective surveillance may incorporate use of telephone calls, physician office records, and death certificates. Most functional outcome measures will require patient examinations or face-to-face interviews. The problem of multiple records stored and analyzed over time has been reduced significantly by the widespread availability of personal computers and easy-to-use data management software. Nevertheless, considerable advance thought and planning is needed to conduct comprehensive analyses of in-hospital resuscitations.

5. Gold standard for outcome comparisons

5.1. Comparing resuscitation success among hospitals

The task force carefully thought about whether one of the survival rates included in template boxes 10 (discharged alive), 11 (died within 1 year of discharge), or 12 (alive at 1 year) should be defined as the gold standard for interhospital and intrahospital comparisons. The most attractive rate appears to be the percentage of survival from arrest to hospital discharge. This rate is analogous to the gold standard recommended for out-of-hospital cardiac arrest: survival rate to hospital discharge of patients who had nontraumatic, witnessed VF [24,30].
After consideration of the enormous heterogeneity in hospitalized patients who experience cardiac arrest, the task force recognized that a single measure for interhospital comparison would be invalid and unrealistic. The average number of cardiac arrests in BRESUS, which included 12 hospitals, was 240 per hospital per year, or 20 per month. This total must be divided among different etiologies, severities of illness, arrest locations, and other comorbid conditions. The crude survival rates from hospital to hospital vary significantly by the nature of the hospital (community versus tertiary-care referral hospital), by the presence of an emergency department and/or specialized cardiac and other units, and by the demographics of the patient population. The task force recognizes that no individual hospital will have enough patients to support meaningful interhospital outcome comparisons. Therefore, no single gold standard recommendation for outcome comparisons is made. Nevertheless, researchers should provide the survival rates listed above in template boxes 10, 11, and 12.

6. Process gold standard

Although the task force recognizes that interhospital comparisons based on outcome would be invalid, it does recommend comparisons based on process. The task force concluded that a simple and robust gold standard is the time interval from collapse to first shock for patients with documented VF. This interval should be documented for all patient areas. In addition, the hospital must document the time intervals from recognition of the emergency to application of other ALS interventions, including endotracheal intubation and administration of intravenous medications. Therefore, three interhospital comparators are recommended:

- Interval from collapse to first shock for patients in VF or pulseless VT
- Interval from collapse to achievement of advanced airway management
- Interval from collapse to first intravenous administration of epinephrine

7. In-hospital ‘Chain of survival’

To evaluate a hospital according to the three comparators, the separate contributions of early recognition, call for help, and arrival of the cardiac arrest team should be analyzed. The task force recommends comparing the interval from collapse to call for help and the interval from call for help to delivery of definitive interventions (defibrillation, achievement of advanced airway management, and administration of epinephrine).

These proposed comparators make up the major links in an in-hospital chain of survival, a conceptual metaphor that allows in-depth analysis of outcomes for out-of-hospital emergency cardiac care [138–140]. Researchers in the United States, such as Kaye et al., [141–143] have used this concept to model in-hospital cardiac resuscitations and provide an approach to improving outcomes. For most hospitals this requires strengthening the early defibrillation link in the chain of
survival by allowing nonphysician in-hospital responders to perform defibrillation. This concept has received widespread international endorsement by the world's major resuscitation councils [144, 145]. The widespread availability of automated external defibrillators, with their documented ease of training, [146] provides the technological capacity to support such early defibrillation programs.

Fig. 4 demonstrates interventions needed for successful in-hospital resuscitation. The shorter the time interval between these interventions, the higher the probability of survival:
- Emergency is recognized, response team is activated (early access)
- Personnel start CPR (early CPR)
- Personnel assess rhythm and deliver defibrillatory shocks for patients in VF/VT (early defibrillation)
- Personnel arrive and perform endotracheal intubation, establish an intravenous lifeline, deliver resuscitative medications, and consider the differential diagnosis (early ALS)


To assist hospitals in adopting these in-hospital uniform guidelines, most of the essential variables listed in Table 1 have been incorporated into a form titled 'Standard Reporting of In-Hospital Cardiopulmonary Resuscitation' (Fig. 5). Collection of these data will support both patient care and patient quality assessment. This form duplicates the format of cardiac arrest forms already used in many hospitals.

The Utstein Task Force recognized that traditional quality assessment for in-hospital resuscitation served a valuable purpose, but hospitals need to adopt more robust methods to assess the quality of resuscitation, that is, outcome and time trends. In the United States most hospital quality-assessment activities are driven by the requirements of the Joint Commission on Accreditation of Health Care Organizations [147]. Most accredited US hospitals establish a cardiac arrest committee that sets policies for resuscitation responses and reviews the management of all in-hospital cardiac arrest patients. In the majority of US hospitals these code committees evaluate structure (are resuscitation trolleys stocked and equipped? are defibrillators available in all patient care areas? did the equipment function properly?) and some process (were BLS and ALS performed in accordance with accepted standards and guidelines?). These important evaluations should continue to be made.

The process variables recommended (Figs. 4 and 5) by the Utstein Task Force should be associated with superior outcomes, assuming that the lessons in epidemiology and pathophysiology learned out of the hospital apply equally well to the in-hospital setting. Hospital cardiac arrest committees must review the response system continuously and require that these intervention intervals are acceptable. Use of the in-hospital Utstein-style reporting form (Fig. 5) will assist in these activities, as will using the in-hospital Utstein-style template (Fig. 2). The principles of continuous
### STANDARD REPORTING OF IN-HOSPITAL CARDIOPULMONARY RESUSCITATION

<table>
<thead>
<tr>
<th>1 Date of event</th>
<th>4 ALS Interventions at time of event (check all that apply)</th>
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<tbody>
<tr>
<td>Location</td>
<td>Name</td>
</tr>
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<td>Date of birth</td>
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<tr>
<td></td>
<td>Age</td>
</tr>
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<td></td>
<td>M □ F □ Unknown</td>
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<tr>
<td></td>
<td>Admit date</td>
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<td>ID#</td>
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#### EVENT VARIABLES

<table>
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<tr>
<th>5 Immediate cause</th>
<th>7 Initial condition</th>
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<tr>
<td></td>
<td>Conscious? □ Yes □ No</td>
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<tr>
<td></td>
<td>Breathing? □ Yes □ No</td>
</tr>
<tr>
<td></td>
<td>Pulse? □ Yes □ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8 Initial rhythm</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPR stopped _____</td>
</tr>
<tr>
<td>Why?</td>
</tr>
</tbody>
</table>

| 9 Event times |
|               |
| Collapse/onset |
| CPR stopped   |

<table>
<thead>
<tr>
<th>10 Time of awakening</th>
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<tbody>
<tr>
<td>In hospital death (ROSC&gt;24 hours)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>11 In-hospital event outcome (check one)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital discharge</td>
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</table>

| 12 Alive at six months? |
|                         |
|                         |

| 13 Alive at one year? |
|                       |

### OUTCOME VARIABLES

<table>
<thead>
<tr>
<th>14 If died, principal cause of death</th>
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</thead>
<tbody>
<tr>
<td>CAD □ Trauma □ Cancer □ Other medical</td>
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</table>

<table>
<thead>
<tr>
<th>15 ICD-CM code</th>
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</table>

<table>
<thead>
<tr>
<th>16 Information source (for 14 &amp; 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical records □ Death certificate □ Personal physician □ Autopsy □ Other</td>
</tr>
</tbody>
</table>

*CPC (Cerebral Performance Category) 1 = good, 2 = moderate, 3 = severe, 4 = comatose, 5 = brain dead

*GCS (Glasgow Coma Score) eye 1-4, verbal 1-5, motor 1-6.

Fig. 5.
### ADDITIONAL INFORMATION

#### 17 Provider of CPR
- Nurse
- Respiratory therapist
- Physician
- Clinical assistant
- Other

#### 18 ET intubation time

#### 19 Treatments during event (below)

<table>
<thead>
<tr>
<th>Time</th>
<th>Comments</th>
<th>Vitals</th>
<th>Rhythm</th>
<th>Defib (J)</th>
<th>Medications</th>
<th>Dose/route</th>
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</table>

**Please check that all information is complete and accurate**

Fig. 5. Form for standard reporting of in-hospital cardiopulmonary resuscitation. AHA indicates American Heart Association; ALS, advanced life support; CAD, coronary artery disease; CCU, coronary care unit; CPR, cardiopulmonary resuscitation; defib, defibrillation; DNAR, do not attempt resuscitation; ECG, electrocardiographic; ED, emergency department; EPI, epinephrine; ERC, European Resuscitation Council; ET, endotracheal tube; ICD-CM, International Classification of Diseases, ninth edition; ICU, intensive care unit; IV, intravenous; MI, myocardial infarction; PAR, Prognosis After Resuscitation Score; PEA, pulseless electrical activity; ROSC, return of spontaneous circulation; VF, ventricular fibrillation; and VT, ventricular tachycardia.
quality improvement dictate that hospitals address any identified problems and make any necessary adjustments to educational and training programs, equipment, and the system. The AHA ACLS course and similar courses provided by the Resuscitation Council (United Kingdom) and the Scandinavian Resuscitation Council provide a uniform treatment approach to optimize outcomes. Hospitals should strongly encourage all personnel who may be called on to participate in a resuscitation attempt to take these courses and to retake them with appropriate frequency.

In addition, the In-Hospital Utstein Task Force recommends that hospital cardiac arrest committees expand their mandate beyond structure and process concerns for individual patients. Data for the Utstein-style template (Fig. 2) and the recommended uniform data (Table 1 and Fig. 5) support intrahospital outcome assessment and interhospital comparisons. A database containing the information recommended in these guidelines will permit pooling of data for many patients and assessment of trends over time. Outcome information such as resuscitation and discharge rates, functional levels of survivors, and length of survival are all important parameters to assess.

The circumstances, interventions, and responses of a resuscitation attempt constitute a critical part of a patient’s medical record. Although these data should be recorded as completely and accurately as possible, the confusion and urgency of most resuscitation efforts prohibit accurate event documentation. The task force selected uniform in-hospital resuscitation data (see Table 1) and designed the standard reporting form (Fig. 5) to contribute to research, clinical epidemiology, and proper patient care.

In addition, the uniform set of data and standard reporting form will help hospitals reduce the risk of medical litigation. In the United States, unsuccessful resuscitations or resuscitation attempts that leave the survivors neurologically impaired all too often stimulate medical-legal record reviews. Distressed family members contact attorneys, who then commission medical experts to review the records. The focus of these reviews becomes ‘did the emergency providers render proper and timely care?’ and ‘were there any violations of the standard of care that a reasonably prudent physician would provide?’ From the perspective of risk management and avoidance of medical litigation for wrongful death, it is critical that emergency care providers document the events of the resuscitation attempt as accurately and precisely as possible, particularly time from collapse to first defibrillation. Routine completion of the standard reporting form will supply most of the specific details of care needed for medical-legal reviews.

A number of important technological advances promise to make event documentation even more accurate, convenient, and useful. At the center of these technological advances is the defibrillator/monitor. Research has repeatedly shown that defibrillation is the most important intervention in adult resuscitation. Because of the need for early rhythm assessment and defibrillation—every resuscitation attempt requires a defibrillator and monitor-defibrillators have become sophisticated electronic devices for event documentation. Many new technological advances appear first as add-ons to defibrillators (e.g., synchronized cardioversion, transcutaneous pacing, pulse oximetry, capnometry, and automatic blood pressure monitoring).

Critical extra features for defibrillators are automated rhythm analysis capability and shock advisory defibrillation. Both automated and conventional external defibrillators now include several microprocessor-based techniques for event documentation. These techniques include two-channel magnetic tape recorders, Personal Computer Memory Card International Association (PCMCIA) cards, digitized audiotapes, and bar-code readers. The recorded data, which include cardiac rhythm, audio recordings, therapeutic interventions (e.g., administration of medications and intubation), and other patient parameters, can be downloaded to master databases through direct lines, telephone lines, or personal computer card readers. The anticipated widespread greater use of automated external defibrillators during in-hospital arrests should make these approaches readily available [148–150].

Several manufacturers have developed database management software to store and analyze patient care data (e.g., Utstein Reporter™ data management software [Laerdal Medical Company, Stavanger, Norway] and the CODE-STAT™ data management system [Physio-Control Corporation, Redmond, Wash, USA]). These software data management programs comply with the recommendations of the out-of-hospital Utstein-style guidelines and will be upgraded to reflect the recommendations of the in-hospital guidelines.

9. Resuscitation quality during resuscitations

In many institutions a member of the cardiac arrest team fills out an evaluation form that assesses the quality of the resuscitation effort. These reports identify specific problems, such as the adequacy of BLS, delays in arrival of the defibrillator or other equipment, delays in intubation, and possible absence or malfunction of resuscitation equipment. These items may be described in a comments section on the car-
diac arrest audit form. Although essential for in-hos-
pital quality assurance, these items will not be avail-
able for numerical analysis for comparisons between
hospitals. They should be confidential documents for
quality assurance and reviewed only by a properly
authorized committee. They should not become part
of the patient’s medical record.

A growing body of research suggests that resuscita-
tion interventions must be performed not only early
but well. Several studies document that all four of the
major components of resuscitation may be performed
poorly: chest compressions and ventilation rates,
[151–153] defibrillation, [154,155] endotracheal intuba-
tion, and administration of intravenous medications.
In one study of in-hospital resuscitation, 83% of chest
compression rates and 100% of ventilation rates were
outside the recommended BLS guidelines [152]. An-
other project assessed the quality of out-of-hospital
resuscitation and judged 48% of CPR efforts to be
poor [153]. These observations are important because
the quality of CPR efforts correlates with successful
resuscitation [156]. Incorrect CPR was associated with
a 14-day survival rate of 4% compared with a sur-
vival rate of 16% when CPR was performed correctly
[153]. Another study demonstrated that correctly per-
formed bystander CPR was independently associated
with better survival to hospital discharge, while inef-
fective CPR was not associated with improved sur-
vival [151].

In addition to simple observation by resuscitation
team members, researchers have sought a physiologi-
ical variable that can be used to provide feedback to
emergency personnel during resuscitation attempts.
The following variables were examined: hemody-
namics, capnometry, oxygenation, and pulses.

9.1. Hemodynamics

Hemodynamic pressures during cardiac resuscita-
tion correlate well with resuscitation success [157–
161]. Rescuers attempt to optimize coronary perfusion
pressure by increasing the aortic diastolic pressure
with effective chest compressions and pressor agents
[157–161]. Such monitoring, however, requires place-
ment of arterial and central venous catheters during a
cardiac arrest, which is impractical in most resuscita-
tion attempts. If monitoring lines are already in place,
they can provide guidance.

9.2. Capnometry

With constant ventilation and systemic metabolism,
end-tidal CO₂ monitoring reflects cardiac output dur-
ing CPR [162–170]. End-tidal CO₂ concentrations
during CPR correlate with cardiac output, coronary
perfusion pressure, and successful resuscitation [163–
170]. Few patients with low end-tidal CO₂ concen-
trations during CPR are successfully resuscitated [170].
Capnometry appears to be a useful adjunct in assessing
efficacy of the resuscitation efforts. Smaller, less
expensive devices are becoming available.

9.3. Oxygenation

Pulse oximetry is not useful in the assessment of
patients in cardiac arrest. Oximetry requires a periph-
eral pulse that is unavailable during cardiac arrest.
CPR chest compressions do not create a suitable pe-
ripheral pulse. Arterial blood gases demonstrate the
adequacy of oxygenation but do not reflect the ade-
quacy of perfusion during cardiac arrest.

9.4. Pulses

The presence of palpable pulses indicates the pres-
ence of some blood flow but does not provide any
quantification of arterial pressures or cardiac output.
The carotid pulse is the most commonly palpated
pulse during CPR [153]. Femoral pulses should not
be used as an indicator of arterial blood flow during
CPR because compression-induced retrograde flow in
the inferior vena cava produces femoral pulses that
more likely indicate venous rather than arterial blood
flow.

10. Ethical issues

These recommendations for reporting outcomes of
in-hospital resuscitation would be inappropriate with-
out attention to the many ethical issues involved in
both clinical management and research [171–173].
Quality resuscitation research must be conducted. Scien-
tific evaluation of resuscitative efforts can benefit
future patients. This research must be conducted,
however, within an ethical framework, which may
vary among countries and cultures.

10.1. DNAR, no CPR, do not resuscitate

In certain circumstances it is acceptable and appro-
priate to withhold CPR efforts [174,175]. Competent
and informed patients have the right to refuse CPR
[176,177]. When the patient cannot make an informed
decision about CPR, the decision may be based on
the patient’s known wishes expressed through advance
directives.

Substituted judgment, where surrogates make the
decision to withhold CPR, is ethically acceptable. The
accuracy of substituted judgment, however, has been
questioned. Seckler et al. [178] found that only 16% of elderly chronically ill patients had previously discussed resuscitation preferences with their self-chosen family proxies, and neither family members nor physicians were able to predict patients' wishes adequately. Suhl et al. [179] observed that surrogates could not guess patients' wishes better than random chance.

In the United States, where the movement toward patient autonomy is stronger than in most other countries, [180] an increasing number of organizations require hospitals to review the status of advance directives with all admitted patients. Still, according to a recent review, only 20% to 38% of in-hospital patients with AIDS, cancer, or other diseases with poor prognosis had had such discussions. [181] In in-patient medical services in the United States, the frequency of DNAR orders is approximately 3% to 4% but occasionally may run as high as 9% [181].

10.2. Medical futility

Withholding resuscitation attempts because of medical futility, that is, the probability of a successful outcome approaches zero, remains controversial [182–184]. Most consensus panels from major health organizations (including the AHA, [185] the European Resuscitation Council, [173] the American Medical Association, [186] and the Hastings Center [174]) have concluded that it is ethically acceptable to withhold CPR when an informed physician thinks resuscitation attempts will be futile. An unambiguous and widely accepted definition of futility is still lacking. Hidden value judgments may be made by clinicians who declare futility without consultation with the patient or surrogate [187,188].

Some investigators make a distinction between qualitative and quantitative medical futility [187]. Quantitative futility is a very low or zero probability of achieving a return of organ function and survival beyond 2 weeks. Qualitative medical futility applies when CPR may be effective in sustaining life, but the patient's quality of life falls well below the threshold considered minimal by general professional judgment [187]. In one study investigators observed that clinicians failed to discuss quality-of-life issues with a substantial number of communicative patients for whom qualitative futility was declared [187]. As a concept, medical futility must be better defined and more widely accepted if it is to affect withholding medical interventions.

10.3. Informed consent for resuscitation research

Resuscitation research presents unique ethical challenges. Most tellingly, patients cannot give informed consent for participation in research protocols. Patients' wishes concerning care are often unknown at the time resuscitation efforts are undertaken. Most reports of human resuscitation research fail to report approval by research ethics committees or to address issues of subject consent [189]. Surrogate permission, from family members when applicable, is rarely available [190,191]. In the United States, federal regulations concerning informed consent resulted in a virtual halt in resuscitation research for several years in the 1990s [192].

In response, the 1995 Coalition Conference of Acute Resuscitation and Critical Care Researchers stated that research can and should be done in clinical circumstances where it is not feasible to obtain informed, prospective, or proxy consent for enrollment in a study protocol [191]. The coalition emphasized the critical role of informed institutional review boards in circumstances in which obtaining informed consent is impossible. The local institutional review boards must establish safeguards and reviews to protect the interests and rights of potential subjects. In addition, the coalition endorsed a new risk category called 'appropriate incremental risk.' Incremental risk is any potential risk specifically associated with participation in the research compared with the natural consequences of the medical condition. Although patients are indeed vulnerable to research risks, they are also at risk of being denied beneficial therapy when no effective therapy currently exists.

In late 1996 the US Food and Drug Administration published an important 'final rule' regarding exception to informed consent in certain emergency research circumstances. When implemented, these regulations should allow full resumption of clinical resuscitation research even when informed consent is impossible. The circumstances under which exceptions to informed consent can be made must meet the following criteria:

1. The clinical trial addresses a life-threatening condition that the individual to be enrolled has.
2. Currently available treatments are unproved or unsatisfactory.
3. The research cannot otherwise be carried out and is essential to determine the safety and effectiveness of the new treatment.
4. It is not feasible to obtain informed consent from the patient or a legal representative.
5. The risks of the experimental procedures are reasonable compared with those associated with the patient's medical condition and current standard therapy.

10.4. Additional ethical issues

This consensus document highlights several major ethical issues for researchers, ethics committees, and other involved parties to consider and review. At this time many researchers, clinicians, ethicists, and caregivers are debating a number of other ethical topics, including resuscitation for organ donation, [193] practicing procedures on the newly dead, [194–202] the presence
of relatives during resuscitation attempts, [203–206] and caring for the survivors [207–212]. Although the task force recognizes the critical importance of these topics, consensus on these issues was beyond the scope and mandate of this document. These issues will be discussed in detail in future Utstein symposia.

11. Conclusions

In-hospital resuscitation is a topic of immense complexity. Existing publications more often highlight these intricacies than provide answers. The purpose of this document is as much to list topics for consideration as to provide guidelines to follow. Many of these recommendations are speculative, offered in the absence of results from research studies that use uniform definitions and terminology. They are presented in the belief that they will serve as a catalyst to much-needed research and discussion.

Table 1 lists and defines a series of individual patient variables that hospitals should collect. With these variables, a standard reporting form (Fig. 5) can be completed during and immediately after a resuscitation event. Use of this form (or a similar form that contains the same variables) provides documentation of patient care during the arrest. These arrest reporting forms should become part of the medical record for each patient. Different designs may be required for different hospitals, locations, and countries.

Fig. 2 presents the in-hospital Utstein-style reporting template. This template summarizes the collective experience of individual hospitals. The template can be completed using the uniform data (Table 1) collected from individual patients. Table 2 is a checklist of information to include in reports on in-hospital resuscitation. For future publications on in-hospital resuscitation, this information will allow categorization and comparison of hospitals that may use different management approaches. Table 2 also lists the final recommendations regarding resuscitation outcomes and the gold standard process intervals to report. These variables will supply the key for future interhospital comparisons.

We recognize that many individuals, hospitals, and research groups have already identified, and in many cases solved, some of the data acquisition problems addressed in these guidelines. Many other solutions and forms may exist. These recommendations are a work in progress. We encourage comments, discussion, and suggestions for improvement of the recommendations as they are used. We are particularly interested in solutions to problems of data collection, storage, analysis, and presentation.

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