Part 3: Ethical Issues

Web-based Integrated 2010 & 2015 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Key Words: advance directive | DNAR | life support | organ donation

1 Highlights

As resuscitation practice evolves, ethical considerations must also evolve. Managing the multiple decisions associated with resuscitation is challenging from many perspectives, no more so than when healthcare providers (HCPs) are dealing with the ethics surrounding decisions to provide or withhold emergency cardiovascular interventions.

Ethical issues surrounding whether to start or when to terminate CPR are complex and may vary across settings (in- or out-of-hospital), providers (basic or advanced), and patient population (neonatal, pediatrics, adult). Although ethical principles have not changed since the 2010 Guidelines were published, the data that inform many ethical discussions have been updated through the evidence review process. The 2015 ILCOR evidence review process and resultant AHA Guidelines Update include several science updates that have implications for ethical decision making for periarrest, arrest, and postarrest patients.

Significant New and Updated Recommendations That May Inform Ethical Decisions

- The use of extracorporeal CPR (ECPR) for cardiac arrest
- Intra-arrest prognostic factors
- Review of evidence about prognostic scores for preterm infants
- Prognostication for children and adults after cardiac arrest
- Function of transplanted organs recovered after cardiac arrest

New resuscitation strategies such as ECPR have made decisions to discontinue resuscitation measures more complicated (see the Adult Advanced Cardiovascular Life Support section in this publication). Understanding the appropriate use, implications, and likely benefits related to such new treatments will have an impact on decision making. There is new information about prognostication for neonates, children, and adults in cardiac arrest and after cardiac arrest (see Neonatal Resuscitation, Pediatric Advanced Life Support, and Post–Cardiac Arrest Care). The increased use of targeted temperature management (TTM) has led to new challenges for predicting neurologic outcomes in comatose post–cardiac arrest patients, and the latest data about the usefulness of particular tests and studies should inform decisions about goals of care and limiting interventions.

There is greater awareness that although children and adolescents cannot make legally binding decisions, information should be shared with them to the extent, using appropriate language and information for each patient's level of development. In addition, the phrase *limitations of care* has been changed to *limitations of interventions*, and there is increasing availability of the Physician Orders for Life-Sustaining Treatment (POLST) form, a new method of legally identifying people with specific limits on interventions at the end of life, both in and out of healthcare facilities. Even with new information that the success of kidney and liver transplants from adult donors is unrelated to whether the donor receives CPR, the donation of organs after resuscitation remains controversial. Viewpoints on several important ethical concerns that are the topics of ongoing debate around organ donation in an emergency setting are summarized below in this Web-based Integrated Guidelines document.

2 Introduction - Updated

These Web-based Integrated Guidelines incorporate the relevant recommendations from 2010 and the new or updated recommendations from 2015.

The goals of resuscitation are to preserve life; restore health; relieve suffering; limit disability; and respect individuals' decisions, rights, and privacy. Because cardiopulmonary resuscitation (CPR) efforts must be initiated

immediately at the time of arrest, a rescuer may not know who the victim is, what that individual's goals of care are, or if an advance directive exists. As a result, administration of CPR may be contrary to the individual's desires or best interests.[-2] This Part of the *2015 American Heart Association (AHA) Web-based Integrated Guidelines for CPR and Emergency Cardiovascular Care* provides updates to the 2010 AHA Guidelines[3] for healthcare providers who are faced with the difficult decision to provide or withhold emergency cardiovascular care.

3 Ethical Principles - Updated

Ethical, legal, and cultural factors influence decisions about resuscitation. Ideally, these decisions are guided by science, patient or surrogate preferences, local policies and legal requirements, and established ethical principles.

3.1 Principle of Respect for Autonomy - Updated

Respect for autonomy is an important social value in medical ethics and law.[4] This principle is based on society's respect for a competent individual's ability to make decisions about his or her own health care. Adults are presumed to have decision-making capability unless they are incapacitated or declared incompetent by a court of law. Informed decisions require that individuals receive and understand accurate information about their condition and prognosis as well as the nature, risks, benefits, and alternatives of any proposed interventions. Individuals must deliberate and choose among alternatives by linking their decisions to their values and personal goals of care.

When physicians strive to understand patients' goals of care, decisions can be made based on the likelihood that together they will achieve the patients' goals of care. The following 3-step process may assist healthcare providers in ensuring each patient understands and makes informed decisions: (1) the patient receives and understands accurate information about his or her condition, prognosis, nature of any proposed interventions, alternatives, and risks and benefits; (2) the patient is asked to paraphrase the information to give providers the opportunity to assess the patient's understanding and correct any misimpressions; and (3) the patient deliberates and chooses among alternatives and justifies his or her decisions.[5]

When decision-making capacity is temporarily impaired by conditions such as active illness, treatment of these conditions may restore capacity. When an individual's preferences are unknown or uncertain, it is ethically appropriate to treat emergency conditions until further information is available.

3.1.1 Advance Directives, Living Wills, and Patient Self-Determination

A recent study documented that more than a quarter of elderly patients require surrogate decision making at the end of life. Advance directives, living wills, and executing a durable power of attorney for health care ensure that when the patient is unable to make decisions, the preferences that the individual established in advance can guide care. These decisions are associated with less aggressive medical care near death, earlier hospice referrals for palliation, better quality of life, and caregiver's bereavement adjustment.[6]

A **healthcare advance directive** is a legal binding document that in the United States (US) is based on the Patient Self-Determination Act of 1990.[7] It communicates the thoughts, wishes, or preferences for healthcare decisions that might need to be made during periods of incapacity. The Patient Self-Determination Act mandated that healthcare institutions should facilitate the completion of advance directives if patients desire them.[7] Advance directives can be verbal or written and may be based on conversations, written directives, living wills, or durable power of attorney for health care. The legal validity of various forms of advance directives varies from jurisdiction to jurisdiction. Courts consider written advance directives to be more trustworthy than recollections of conversations.

A **living will** may be referred to as a "medical directive" or "declaration" or "directive to physicians," and it provides written direction to healthcare providers about the care that the individual approves should he or she become terminally ill and be unable to make decisions. A living will constitutes evidence of the individual's wishes, and in most areas it can be legally enforced.

A **durable power of attorney for health care** is a legal document that appoints an authorized person to make healthcare decisions (not limited to end-of-life decisions). Simply put, a living will affects the care received, and a durable power of attorney accounts for unforeseen circumstances. The latter decisions may be in conflict with the living will or advance directive; at the time of the unforeseen circumstances they are considered to be valid

expressions of the patient's best interests.[8]

A **comprehensive healthcare advance directive** combines the living will and the durable power of attorney for health care into one legally binding document.

As a patient's medical condition and desire for types of medical treatment may change over time, all types of advance directives should be revisited regularly. Most importantly the presence of an advance directive, a living will, or a durable power of attorney for health care is closely associated with ensuring that personal preferences match the actual care received, as documented in a survey of surrogates for patients of at least 60 years of age who died between 2000 and 2006 and required surrogate decision making at some point in their care.[8]

A **Do Not Attempt Resuscitation (DNAR) order** is given by a licensed physician or alternative authority as per local regulation, and it must be signed and dated to be valid.[9,10] In many settings, "Allow Natural Death" (AND) is becoming a preferred term to replace DNAR, to emphasize that the order is to allow natural consequences of a disease or injury, and to emphasize ongoing end-of-life care.[11] The DNAR order should explicitly describe the resuscitation interventions to be performed in the event of a life-threatening emergency. In most cases, a DNAR order is preceded by a documented discussion with the patient, family, or surrogate decision maker addressing the patient's wishes about resuscitation interventions. In addition, some jurisdictions may require confirmation by a witness or a second treating physician.

3.1.2 Surrogate Decision Makers

In the event of incapacity, an adult may require a surrogate decision maker to make medical decisions. In the event that the individual has a durable power of attorney for health care, the person appointed by that document is authorized to make medical decisions within the scope of authority granted by the document. If the individual has a court-appointed guardian with authority to make healthcare decisions, the guardian becomes the authorized surrogate.

If there is no court-appointed or other authority, a close relative or friend can become a surrogate decision maker. Most jurisdictions have laws that designate the legally authorized surrogate decision maker for an incompetent patient who has not identified a decision maker through a durable power of attorney for health care. Surrogate decision makers should base their decisions on the individual's previously expressed preferences, if known; otherwise, surrogates should make decisions based on their understanding of what constitutes the best interests of the individual.

3.1.3 Pediatric Decision Making - Updated

As a general rule, minors are considered incompetent to provide legally binding consent about their health care. Parents or guardians are generally empowered to make healthcare decisions on the behalf of minors, and in most situations, parents are given wide latitude in terms of the decisions they make on behalf of their children. Ethically, however, a child should be involved in decision making at a level appropriate for the child's maturity. Children under 14 years of age in Canada and under 18 years of age in the United States rarely possess the legal authority to consent to their health care except under specific legally defined situations (eg, emancipated minors; mature minors; minors who have specific health conditions, such as those with sexually transmitted diseases or in need of pregnancy-related care). However, as older children develop the capacity to make decisions, it is ethically appropriate to include them in discussions about their care and the treatments using language and explanations suitable for the child's level of maturity and cognitive function.

3.2 Principle of Futility

Patients or families may ask for care that is highly unlikely to improve health outcomes. Healthcare providers, however, are not obliged to provide such care when there is scientific and social consensus that the treatment is ineffective. If the purpose of a medical treatment cannot be achieved, the treatment can be considered futile.

An objective criterion for medical futility was defined in 1990 for interventions and drug therapy as imparting a <1% chance of survival.[12] Although this criterion may be controversial, it remains a basis for current futility research. An obvious example of an inappropriate or futile intervention is providing CPR for a patient who has suffered irreversible death.

Conditions such as irreversible brain damage or brain death cannot be reliably assessed or predicted at the time of cardiac arrest. Withholding resuscitation and the discontinuation of life-sustaining treatment during or after resuscitation are ethically equivalent. In situations where the prognosis is uncertain, a trial of treatment may be initiated while further information is gathered to help determine the likelihood of survival, the patient's preferences, and the expected clinical course. (Class IIb, LOE C)

4 Withholding and Withdrawing CPR (Termination of Resuscitative Efforts) - Updated

4.1 Out-of-Hospital Cardiac Arrest (OHCA) - Updated

4.1.1 Criteria for Not Starting CPR - Updated

While the general rule is to provide emergency treatment to a victim of cardiac arrest, there are a few exceptions where withholding CPR would be considered appropriate:

- Situations where attempts to perform CPR would place the rescuer at risk of serious injury or mortal peril (eg, exposure to infectious diseases).
- Obvious clinical signs of irreversible death (eg, rigor mortis, dependent lividity, decapitation, transection, decomposition).
- A valid advance directive, a Physician Orders for Life- Sustaining Treatment (POLST) form[13] (www.polst.org) indicating that resuscitation is not desired, or a valid Do Not Attempt Resuscitation (DNAR) order.

4.1.2 DNAR Orders in OHCA

Out-of-hospital DNAR protocols must be clearly written and easily implemented for all involved (all members of the healthcare team, patients, family members, and loved ones). DNAR documentation can take many forms (eg, written bedside orders, wallet identification cards, identification bracelets, or predefined paper documents approved by the local emergency medical services [EMS] authority). The ideal out-of-hospital DNAR documentation is portable and can be carried on the person, such as a POLST form.[10]

Delayed or token efforts such as so-called "slow-codes" (knowingly providing ineffective resuscitative efforts) are inappropriate. This practice compromises the ethical integrity of healthcare providers, uses deception to create a false impression, and may undermine the provider-patient relationship. The practice of "pseudo resuscitation" was self-reported by paramedics to occur in 27% of cardiac arrests in a community where a prehospital DNAR and termination-of-resuscitation protocols were not in place.[14]

Some EMS systems have extended the DNAR protocol to include verbal DNAR requests from family members as grounds to withhold therapy.[15,16] Paramedics withheld care to patients in cardiac arrest with a history of a terminal illness, who were under the care of a physician, and when at the time of the cardiac arrest the family requested that resuscitation not be attempted. The numbers of patients for whom resuscitation was withheld doubled after implementation (from 45 to 99 a year). This is an important first step in expanding the clinical decision rule pertaining to when to start resuscitation in OHCA, however there is insufficient evidence to support this approach without further validation.

4.1.3 Advance Directives in OHCA

Advance directives do not have to include a DNAR order, and a DNAR order is valid without an advance directive. A significant number of cardiac arrest victims for whom EMS is summoned have a terminal illness, and many have written advance directives. Laws detailing the actions of a prehospital provider in response to an out-of-hospital DNAR order vary across jurisdictions. In general, EMS professionals should initiate CPR and advanced life support if there is reasonable doubt about the validity of a DNAR order, if there is concern that the victim may have had a change of mind, or if there is a question about whether the patient intended the advance directive to be applied under the actual conditions for which EMS has been called.

The DNAR order should be shown to EMS responders as soon as they arrive on the scene. If the EMS professional cannot obtain clear information about the victim's wishes, they should not hesitate to start resuscitation. Sometimes within a few minutes of starting resuscitation, relatives or other medical personnel will arrive and confirm that the victim had clearly expressed a wish that resuscitation not be attempted. CPR or other

life-support measures may be discontinued by following local directives or protocols, which may include real-time consultation with medical direction.

4.1.4 Terminating Resuscitative Efforts in Neonatal, Pediatric, or Adult OHCA - Updated

The 2010 Guidelines contains a complete discussion of clinical decision rules for terminating resuscitative efforts. [3] This discussion is included in this integrated document.

In 2015, the International Liaison Committee on Resuscitation (ILCOR) Neonatal Life Support Task Force and the Pediatric Life Support Task Force completed systematic reviews to examine whether the presence of certain prognostic factors in the newly born or in infants or children enabled prediction of good neurologic outcome (see "Part 12: Pediatric Advanced Life Support" and "Part 13: Neonatal Resuscitation").

In the absence of clinical decision rules for the neonate, infant, child, or adult out-of-hospital cardiac arrest (OHCA) victim, CPR and advanced life support protocols are used by responsible prehospital providers in consultation with medical direction in real-time or as the victim is transported to the most appropriate facility per local directives. The impact of the availability of advanced hospital-based interventions, including extracorporeal membrane oxygenation (ECMO) during refractory CPR and the use of targeted temperature management (TTM), is now being considered in the local evaluation for continuing resuscitation and transport in some emergency medical service systems.[17-19]

The remainder of this section covers the 2010 content about Terminating Resuscitative Efforts in OHCA.

4.1.5 Terminating Resuscitative Efforts in Neonatal or Pediatric OHCA

No predictors of neonatal or pediatric (infant or child) out-of-hospital resuscitation success or failure have been established. No validated clinical decision rules have been derived and evaluated. Further research in this area is needed.

In the absence of clinical decision rules for the neonatal or pediatric OHCA victim, the responsible prehospital provider should follow BLS pediatric and advanced cardiovascular life support protocols and consult with real-time medical direction or transport the victim to the most appropriate facility per local directives.

4.1.6 Terminating Resuscitative Efforts in Adult OHCA

4.1.6.1 BLS Out-of-Hospital System

Rescuers who start BLS should continue resuscitation until one of the following occurs:

- Restoration of effective, spontaneous circulation
- Care is transferred to a team providing advanced life support
- The rescuer is unable to continue because of exhaustion, the presence of dangerous environmental hazards, or because continuation of the resuscitative efforts places others in jeopardy
- Reliable and valid criteria indicating irreversible death are met, criteria of obvious death are identified, or criteria for termination of resuscitation are met.

One set of reliable and valid criteria for termination of resuscitation is termed the "BLS termination of resuscitation rule" (see Figure 1.[20] All 3 of the following criteria must be present before moving to the ambulance for transport, to consider terminating BLS resuscitative attempts for adult victims of out-of-hospital cardiac arrest: (1) arrest was not witnessed by EMS provider or first responder; (2) no return of spontaneous circulation (ROSC) after 3 full rounds of CPR and automated external defibrillator (AED) analysis; and (3) no AED shocks were delivered.

Figure 1: BLS Termination of Resuscitation Rule for Adult OHCA

BLS Termination of Resuscitation

> Arrest not witnessed by emergency medical services personnel
> No return of spontaneous circulation (prior to transport)
> No AED shock was delivered (prior to transport)

> If ALL criteria are present, consider termination of resuscitation

> If ANY criteria are missing, continue resuscitation and transport
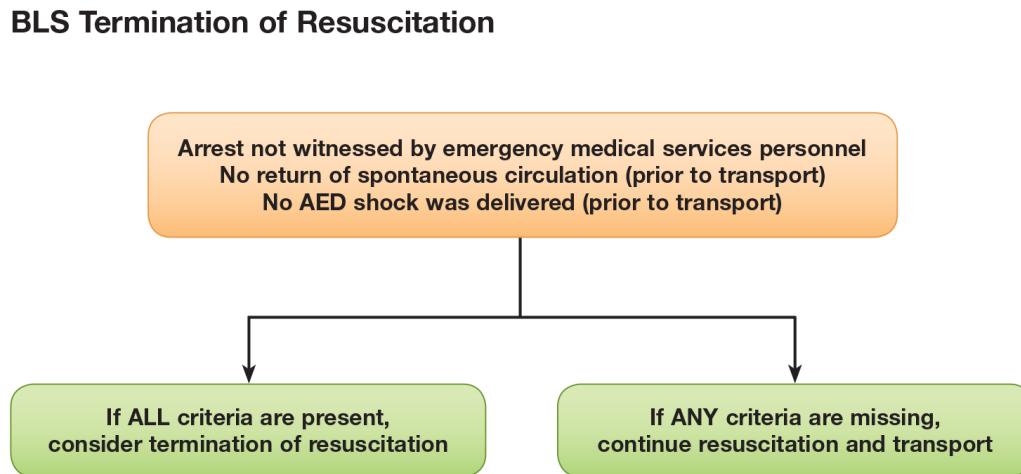
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BLS termination-of-resuscitation rule for adult OHCA.

The BLS termination of resuscitation rule can reduce the rate of hospital transport to 37% of cardiac arrests without compromising the care of potentially viable patients. This was prospectively validated in rural and urban EMS services[20] and externally validated in additional locations in the US, Canada, and Europe.[21-26] The rule should be applied before moving to the ambulance for transport.[27] This clinical prediction rule consistently generates the highest specificity and positive predictive values when compared to previous guidelines.[26]

It is recommended that regional or local EMS authorities use the BLS termination rule to develop protocols for the termination of resuscitative efforts by BLS providers for adult victims of cardiac arrest in areas where advanced life support is not available or may be significantly delayed. (Class I, LOE A)

The reliability and validity of this rule is uncertain if modified. (Class IIb, LOE A)

Implementation of the rule includes real-time contacting of medical control when the rule suggests termination. Before the protocol is implemented, EMS providers require training in sensitive communication with the family about the outcome of the resuscitative attempt.[28] This strategy will help to ensure comfort of the provider and appropriate support of the grieving family. Support for the prehospital protocol should be sought from collaborating external agencies (eg, destination hospital emergency departments [EDs], coroner, medical directors, and police) before implementation.

4.1.6.2 ALS Out-of-Hospital System

A different rule may be useful when the additional diagnostic and therapeutic capabilities of an advanced life support EMS response are available to the victim. The National Association of EMS Physicians (NAEMSP) suggested that resuscitative efforts could be terminated in patients who do not respond to at least 20 minutes of ALS care.[29]

An ALS termination of resuscitation rule was derived from a diverse population of rural and urban EMS settings.[30] This rule recommends considering terminating resuscitation when ALL of the following criteria apply before moving to the ambulance for transport (see Figure 2): (1) arrest was not witnessed;

(2) no bystander CPR was provided; (3) no ROSC after full ALS care in the field; and (4) no AED shocks were delivered. This rule has been retrospectively externally validated for adult patients in several regions in the US, Canada, and Europe,[22],[24-26] and it is reasonable to employ this rule in all ALS services. *(Class IIa, LOE B)*

See Figure 2 in relation to this recommendation statement.

Figure 2: ALS Termination of Resuscitation Rule for Adult OHCA

ALS Termination of Resuscitation

> **Arrest not witnessed by emergency medical services personnel**
> **No return of spontaneous circulation (prior to transport)**
> **No AED shock was delivered (prior to transport)**

| If ALL criteria are present, consider termination of resuscitation | If ANY criteria are missing, continue resuscitation and transport. |
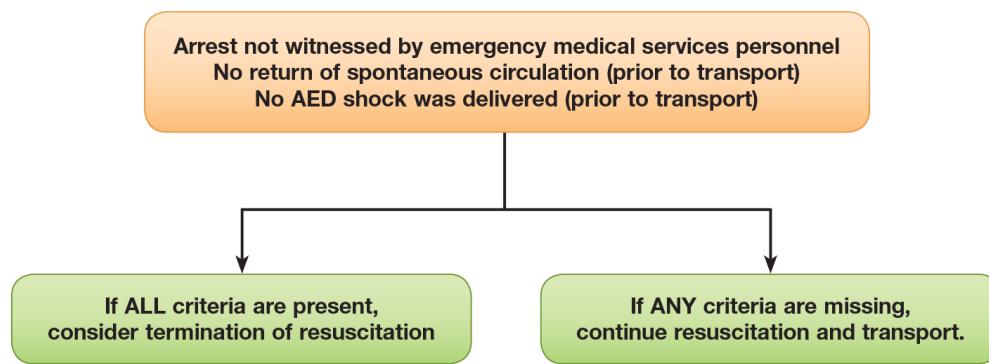
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ALS termination-of-resuscitation rule for adult OHCA.

4.1.6.3 Combined BLS and ALS Out-of-Hospital System

In a tiered ALS- and BLS-provider system, the use of a universal rule can avoid confusion at the scene of a cardiac arrest without compromising diagnostic accuracy.[22],[25],[26] The BLS rule is reasonable to use in these services. (Class IIa, LOE B)

4.1.6.4 Transport Implications

Field termination reduces unnecessary transport to the hospital by 60% with the BLS rule and 40% with the ALS rule,[22] reducing associated road hazards[31],[32] that put the provider, patient, and public at risk. In addition field termination reduces inadvertent paramedic exposure to potential biohazards and the higher cost of ED pronouncement.[33-35] More importantly the quality of CPR is compromised during transport, and survival is linked to optimizing scene care rather than rushing to hospital.[36-38]

4.1.7 Use of Extracorporeal CPR for Adults with OHCA - Updated

The use of extracorporeal CPR (ECPR) may allow providers additional time to treat reversible underlying causes of cardiac arrest (eg, acute coronary artery occlusion, pulmonary embolism, refractory ventricular fibrillation, profound hypothermia, cardiac injury, myocarditis, cardiomyopathy, congestive heart failure, drug intoxication) or serve as a bridge for left ventricular assist device implantation or cardiac transplant.

4.1.7.1 2015 Evidence Summary

The 2015 ILCOR systematic review evaluated the use of ECPR techniques (including ECMO or cardiopulmonary bypass) compared with manual CPR or mechanical CPR. One post hoc analysis of data from a prospective, observational cohort of 162 OHCA patients who did not achieve return of spontaneous circulation (ROSC) with more than 20 minutes of conventional CPR, including propensity score matching, showed that at 3-month follow-up ECPR was associated with a higher rate of neurologically intact survival than continued conventional CPR.[39]

A single prospective, observational study that enrolled 454 patients with OHCA who were treated with ECPR if they did not achieve ROSC with more than 15 minutes of conventional CPR after hospital arrival demonstrated improved neurologic outcomes at 1-month and 6-month follow-ups.[40]

4.1.7.2 2015 Recommendation - Revised [ALS 723]

There is insufficient evidence to recommend the routine use of ECPR for patients with cardiac arrest.

In settings where it can be rapidly implemented, ECPR may be considered for select cardiac arrest patients for whom the suspected etiology of the cardiac arrest is potentially reversible during a limited period of mechanical cardiorespiratory support. *(Class IIb, LOE C-LD)*

4.1.8 Intra-arrest Prognostic Factors for Cardiac Arrest in Infants and Children - Updated

The ILCOR Pediatric Life Support Task Force reviewed the available evidence to determine if there were intra-arrest prognostic indicators that reliably predict survival with good neurologic outcome for OHCA.

4.1.8.1 2015 Evidence Summary

For infants and children with OHCA, age of less than 1 year,[41,42] longer duration of cardiac arrest,[43-45] and presentation with a nonshockable as opposed to a shockable rhythm[41,42,44] are all predictors of poor patient outcome.

4.1.8.2 2015 Recommendation - New [PEDS 814]

Multiple variables should be used when attempting to prognosticate outcomes during cardiac arrest. *(Class I, LOE C-LD)*

Although there are factors associated with better or worse outcomes, no single factor that was studied predicts outcome with sufficient accuracy to recommend termination or continuation of CPR.

4.2 In-Hospital Cardiac Arrest (IHCA) - Updated

4.2.1 Limitation of Interventions and Withdrawal of Life-Sustaining Therapies - Updated

This topic was last reviewed in 2010. Since that time, the term *limitation of interventions* has replaced *limitations of care*.[3] In the 2010 Guidelines, it was noted that not initiating resuscitation and discontinuing life-sustaining treatment of in-hospital cardiac arrest (IHCA) during or after resuscitation are ethically equivalent, and clinicians should not hesitate to withdraw support on ethical grounds when functional survival is highly unlikely.

The 2010 Guidelines are as follows:

Limitation of interventions or withdrawal of life-sustaining therapies is an emotionally complex decision for family and staff. Withholding and withdrawing life support are ethically similar. A decision to limit interventions or withdraw life support is justifiable if the patient is determined to be brain dead, if the physician and patient or surrogate agree that treatment goals cannot be met, or if the burden to the patient of continued treatment is believed to exceed any benefits.

Patients in the end stage of an incurable disease should receive care that ensures their autonomy, comfort, and dignity. Interventions that minimize suffering and pain, dyspnea, delirium, convulsions, and other terminal complications should always be provided. For such patients it is ethically acceptable to gradually increase the doses of narcotics and sedatives to relieve pain and other suffering, even to levels that might concomitantly shorten the patient's life. The care team should initiate plans for future care by collaborative discussions and the resolution of any conflicts with nurses, consultants, residents, fellows, the patient (when capable of participating), surrogate decision makers, and the family. Nursing and comfort care (eg, oral hygiene, skin care, patient positioning, and measures to relieve pain and suffering) must always be continued.

In the absence of evidence of an incurable disease in the end stage, decisions to withdraw or limit interventions in the post-arrest patient are often challenging, given the difficulties of accurate prognostication, especially in the era of treatment advances such as therapeutic hypothermia.

4.2.2 Criteria for Withholding and Discontinuing CPR in Newly Born Infant IHCA - Updated

There are prescribed recommendations to guide the initiation of resuscitative efforts in newly born infants. When gestational age, birth weight, or congenital anomalies are associated with almost certain early death and when unacceptably high morbidity is likely among the rare survivors, resuscitation is not indicated. Examples may include extreme prematurity (gestational age (Class IIb, LOE C)

In conditions associated with uncertain prognosis where survival is borderline, the morbidity rate is relatively high, and the anticipated burden to the child is high, parental desires concerning initiation of resuscitation should be supported. (Class IIb, LOE C)

There should be a consistent and coordinated approach from the obstetric and neonatal teams in applying these guidelines and in communicating with the parents in developing an agreed-upon management plan when possible.

As referenced above, in the 2010 Guidelines, the data regarding management of neonates born at the margins of viability or those with conditions that predict a high risk of mortality or morbidity were reviewed, and it was concluded that there was variation in attitudes and practice by region and availability of resources. Moreover, it was emphasized that parents desire a larger role in decisions related to initiation of resuscitation and continuation of support of severely compromised newborns. Guidelines were provided for when resuscitation is not indicated or when it is nearly always indicated. Under circumstances when the outcome remains unclear, the desires of the parents should be supported.[3]

4.2.3 Criteria for Not Starting CPR in Pediatric and Adult IHCA

Few criteria can accurately predict the futility of continued resuscitation. In light of this uncertainty, all pediatric and adult patients who suffer cardiac arrest in the hospital setting should have resuscitative attempts initiated unless the patient has a valid DNAR order or has objective signs of irreversible death (eg, dependent lividity).

4.2.4 DNAR Orders in IHCA

Unlike other medical interventions, CPR is initiated without a physician's order, based on implied consent for emergency treatment. A licensed physician's order is necessary to withhold CPR in the hospital setting. Physicians should initiate a discussion about the use of CPR with all patients admitted for medical and surgical care or with their surrogates. Terminally ill patients may fear abandonment and pain more than death, so physicians should also reassure the patient and family that control of pain and other symptoms as well as other aspects of support will continue even if resuscitation is withheld.

The attending physician should write the DNAR order in accordance with local policy in the patient's chart, with a note explaining the rationale for the DNAR order, other specific limitations of care, and documenting discussions with the patient, surrogate, and family. Oral DNAR orders are not acceptable. The limitation-of-treatment order should provide explicit instructions for specific emergency interventions that may arise, including the use of vasopressor agents, mechanical ventilation, blood products, or antibiotics. The scope of a DNAR order should specify which interventions are to be withheld.

It is important to emphasize that all other care should be administered without delay and as appropriate for all patients. A DNAR order does not automatically preclude interventions such as administration of parenteral fluids, nutrition, oxygen, analgesia, sedation, antiarrhythmics, or vasopressors, unless these are included in the order. Some patients may choose to accept defibrillation and chest compressions but not intubation and mechanical ventilation. DNAR orders carry no implications about other forms of treatment, and other aspects of the treatment plan should be documented separately and communicated to members of the healthcare team. DNAR orders should be reviewed periodically as per local protocol, particularly if the patient's condition changes.[46] DNAR orders should also be reviewed before surgery by the anesthesiologist, attending surgeon, and patient or surrogate to determine their applicability in the operating suite and during the immediate postoperative recovery period.[47]

4.2.5 Use of a Prognostic Score in the Delivery Room for Preterm Infants - Updated NRP 805

The 2015 ILCOR systematic review evaluated studies about prognostic scores applied to extremely preterm infants (below 25 weeks) compared with assessment of gestational age only.

4.2.5.1 2015 Recommendation - Updated

The data regarding prognostic scores are challenging to evaluate because of the difficulty in distinguishing between outcomes that are driven by practice and current belief about survivability, decision making by parents, and actual physiologic limitations of prematurity.

Antenatal assignment of prognosis for survival and/or disability of the neonate born extremely preterm has generally been made on the basis of gestational age alone. Scoring systems for including additional variables such as gender, use of maternal antenatal steroids, and multiplicity have been developed in an effort to improve prognostic accuracy. Indeed, it was suggested in the 2010 Guidelines that decisions regarding morbidity and risks of mortality may be augmented by the use of published tools based on data from specific populations.[48]

There is no evidence to support the prospective use of any particular delivery room prognostic score presently described, over gestational age assessment alone, in preterm infants at less than 25 weeks of gestation. Importantly, no score has been shown to improve the clinician's ability to estimate likelihood of survival through the first 18 to 22 months after birth.

However, in individual cases, when counseling a family and constructing a prognosis for survival at gestations below 25 weeks, it is reasonable to consider variables such as perceived accuracy of gestational age assignment, the presence or absence of chorioamnionitis, and the level of care available for the location of delivery. It is also recognized that decsions about appropriateness of resuscitation below 25 weeks of gestation will be influenced by region-specific guidelines. In making this statement, a higher value was placed on the lack of evidence for a generalized prospective approach to changing important outcomes over improved retrospective accuracy and locally validated counseling policies. The most useful data for antenatal counseling provides outcome figures for infants alive at the onset of labor, not only for those born alive or admitted to a neonatal intensive care unit.[49-54]
(Class IIb, LOE C-LD)

4.2.6 Terminating Resuscitative Efforts in Term Infants - Updated [NRP 896]

Noninitiation of resuscitation and discontinuation of life-sustaining treatment during or after resuscitation are ethically equivalent, and clinicians should not hesitate to withdraw support when functional survival is highly unlikely.[55] The following guidelines must be interpreted according to current regional outcomes.[56]

The 2015 ILCOR systematic review examined whether outcome is changed by continuing resuscitative efforts in late preterm and term infants with an Apgar score of 0 after 10 minutes of adequate resuscitation.

4.2.6.1 2015 Recommendation - Updated

An Apgar score of 0 at 10 minutes is a strong predictor of mortality and morbidity in late preterm and term infants.

We suggest that, in infants with an Apgar score of 0 after 10 minutes of resuscitation, if the heart rate remains undetectable, it may be reasonable to stop assisted ventilation; however, the decision to continue or discontinue resuscitative efforts must be individualized. Variables to be considered may include whether the resuscitation was considered optimal; availability of advanced neonatal care, such as therapeutic hypothermia; specific circumstances before delivery (eg, known timing of the insult); and wishes expressed by the family. [53],[57-61] (Class IIb, LOE C-LD)

For further information, see "Part 13: Neonatal Resuscitation."

4.2.7 Terminating Resuscitative Efforts in Pediatric or Adult IHCA - Updated

4.2.7.1 Use of ECPR in IHCA - Updated [ALS 723]   [PEDS 407]

To answer the question of whether outcome is changed by the use of ECPR for individuals in IHCA, the available

evidence was reviewed by the ILCOR Advanced Life Support and Pediatric Task Forces.

4.2.7.1.1 2015 Evidence Summary

The 2015 ILCOR review process evaluated the use of ECPR techniques (including ECMO or cardiopulmonary bypass) compared with manual CPR or mechanical CPR for adult survival from IHCA in any setting. One propensity-matched, prospective, observational study that enrolled 172 patients with IHCA reported greater likelihood of ROSC and improved survival at hospital discharge, 30-day follow-up, and 1-year follow-up with the use of ECPR among patients who received more than 10 minutes of CPR. However, this study showed no difference in neurologic outcomes.[62] A single propensity- matched, retrospective, observational study that enrolled 118 patients with IHCA who underwent more than 10 minutes of CPR and then ECPR after cardiac arrest of cardiac origin showed no survival or neurologic benefit over conventional CPR at the time of hospital discharge, 30-day follow-up, or 1-year follow-up.[62-64] A single retrospective, observational study that enrolled 120 patients with witnessed IHCA who underwent more than 10 minutes of CPR reported a modest benefit over historical controls with the use of ECPR over continued conventional CPR in both survival and neurologic outcome at discharge and 6-month follow-up.[64]

For infants and children in IHCA, the evidence comparing standard resuscitation with standard resuscitation plus ECMO was reviewed. Most studies were not robust, and there was little evidence of benefit overall; however, the outcome of some patients, such as those with underlying heart disease, may be improved.[65-70]

4.2.7.1.2 2015 Recommendations - New

There is insufficient evidence to recommend the routine use of ECPR for patients with cardiac arrest.

In settings where it can be rapidly implemented, ECPR may be considered for select cardiac arrest patients for whom the suspected etiology of the cardiac arrest is potentially reversible during a limited period of mechanical cardiorespiratory support. (Class IIb, LOE C-LD)

ECPR may be considered for pediatric patients with cardiac diagnoses who have IHCA in settings with existing ECMO protocols, expertise, and equipment. (Class IIb, LOE C-LD)

In making these recommendations, the reviewers noted that the published series used rigorous inclusion criteria to select patients for ECPR, and this recommendation should apply to similar populations. ECMO is a resource-intensive and invasive therapy with potential for harm that must be balanced against the potential for benefit based on individual clinical situations.

4.2.7.2 Terminating Cardiac Arrest Resuscitative Efforts in Pediatric IHCA - Updated[PEDS 814]

In the 2010 Guidelines, it was noted that no predictors of pediatric (infant or child) resuscitative success or failure have been established. The 2015 ILCOR systematic review examined whether there were any intra-arrest prognostic indicators that reliably predicted survival with good neurologic outcome for IHCA in infants and children and updated several of the prior recommendations.

4.2.7.2.1 2015 Evidence Summary

For infants and children with IHCA, negative predictive factors include age of over 1 year[71] and longer durations of cardiac arrest.[71-74] The evidence is contradictory as to whether a nonshockable (as opposed to shockable) initial cardiac arrest rhythm is a negative predictive factor in the in-hospital setting.[71,75,76]

4.2.7.2.2 2015 Recommendation - Updated

Multiple variables should be used when attempting to prognosticate outcomes during cardiac arrest. (Class I, LOE C-LD)

Although there are factors associated with better or worse outcomes, no single factor studied predicts outcome with sufficient accuracy to recommend termination or prolongation of CPR.

4.2.7.3 Prognostication During CPR - Updated

The 2015 ILCOR ALS systematic review considered one intra-arrest modality, end-tidal CO_2 (ETCO$_2$) measurement, in prognosticating outcome from cardiac arrest in adults. This section focuses on whether a specific ETCO$_2$ threshold can reliably predict ROSC and survival or inform a decision to terminate resuscitation efforts. For further information on the use of ETCO$_2$, see "Part 7: Adult Advanced Cardiovascular Life Support."

4.2.7.3.1 2015 Evidence Summary

Studies on the predictive capacity of ETCO$_2$ among intubated patients during cardiac arrest resuscitation are observational, and none have investigated survival with intact neurologic outcome. An ETCO$_2$ less than 10 mmHg immediately after intubation and 20 minutes after the initiation of resuscitation was associated with extremely poor chances for ROSC and survival in several observational studies.[77-81] Although these results suggest that ETCO$_2$ can be a valuable tool to predict futility during CPR, potential confounding reasons for a low ETCO$_2$ and the relatively small numbers of patients in these studies suggest that the ETCO$_2$ should not be used alone as an indication to terminate resuscitative efforts. However, the failure to achieve an ETCO$_2$ greater than 10 mmHg despite optimized resuscitation efforts may be a valuable component of a multimodal approach to deciding when to terminate resuscitation.

There are no studies that assess the prognostic value of ETCO$_2$ measurements sampled from a supraglottic airway or bag-mask device in predicting outcomes from a cardiac arrest.

4.2.7.3.2 2015 Recommendation - New ALS 459

In intubated patients, failure to achieve an ETCO2 of greater than 10 mm Hg by waveform capnography after 20 minutes of CPR may be considered as one component of a multimodal approach to decide when to end resuscitative efforts, but should not be used in isolation. (Class IIb, LOE C-LD)

The above recommendation is made with respect to ETCO$_2$ in patients who are intubated, because the studies examined included only those who were intubated.

In nonintubated patients, a specific ETCO2 cutoff value at any time during CPR should not be used as an indication to end resuscitative efforts. (Class III: Harm, LOE C-EO)

5 Providing Emotional Support to the Family

5.1 Providing Emotional Support to the Family During Resuscitative Efforts in Cardiac Arrest

In the past, family members have often been excluded from being present during the attempted resuscitation of a child or other relative. Surveys suggest that healthcare providers hold a range of opinions about the presence of family members during resuscitative attempts.[82-93] One theoretical concern is the potential for family members to become disruptive, interfere with resuscitative procedures, or develop syncope, and another is the possibility of increased exposure to legal liability; however, these are not reported in the literature.

Several surveys suggested that most family members wish to be present during a resuscitative attempt.[86-90] Family members with no medical background have reported that being at a loved one's side and saying goodbye during the final moments of life was comforting.[86,87,91] Family members have also reported that it helped them to adjust to the death of their loved one,[92,94] and most indicated that they would do so again.[91] Several retrospective reports note positive reactions from family members,[82-84] many of whom said that they felt a sense of having helped their loved one and of easing their own grieving.[85] Most parents surveyed indicated that they wanted to be offered the option of being present during the resuscitative effort for their child.[85,95-103]

In the absence of data documenting harm and in light of data suggesting that it may be helpful, offering

select family members the opportunity to be present during a resuscitation is reasonable and desirable (assuming that the patient, if an adult, has not raised a prior objection).
(Class IIa, LOE C for adults and Class I, LOE B for pediatric patients)

Parents and other family members seldom ask if they can be present unless they are encouraged to do so by healthcare providers. Resuscitation team members should be sensitive to the presence of family members during resuscitative efforts, assigning a team member to remain with the family to answer questions, clarify information, and otherwise offer comfort.[90]

5.2 Providing Emotional Support to the Family After Termination of Resuscitative Efforts in Cardiac Arrest

Notifying family members of the death of a loved one is an important aspect of a resuscitation that should be performed compassionately, with care taken to consider the family's culture, religious beliefs and preconceptions surrounding death, and any guilt they may feel associated with the event or circumstances preceding the event.[104]

6 Prognostication After Cardiac Arrest - Updated

6.1 Predicting Neurologic Outcome in Pediatric Patients After ROSC - Updated

There continues to be insufficient evidence to recommend or describe an approach to accurately predict the neurologic outcome of pediatric patients after cardiac arrest. Since the publication of the 2010 Guidelines, there have been an increasing number of publications associating a variety of findings with poor neurologic prognosis in these populations. Early and reliable prognostication of neurologic outcome in pediatric survivors of cardiac arrest is helpful for effective planning and family support and can inform decisions to continue or discontinue life-sustaining therapy.

6.2 Postresuscitation Use of Electroencephalography for Prognosis in Pediatric Survivors of Cardiac Arrest - Updated

The 2015 ILCOR Pediatric Life Support Task Force examined the usefulness of electroencephalography (EEG) or evoked potential assessment to predict long-term good neurologic outcome in infants and children who have survived cardiac arrest.

6.2.1 2015 Evidence Summary

Observational data from 2 small pediatric studies[105],[106] showed that a continuous and reactive tracing on EEG performed in the first 7 days after cardiac arrest was associated with a significantly higher likelihood of good neurologic outcome at hospital discharge, whereas an EEG demonstrating a discontinuous or isoelectric tracing was associated with a poorer neurologic outcome at hospital discharge.

6.3 Predictive Factors After Cardiac Arrest in Pediatric Patients - Updated PEDS 822   PEDS 813

The 2015 systematic review examined whether there were factors that could assist with prognostication for pediatric patients who remained unconscious after cardiac arrest.

6.3.1 2015 Evidence Summary

Four observational studies supported the use of pupillary reactivity at 12 to 24 hours after cardiac arrest in predicting survival to discharge,[44,74,106,107] while 1 observational study found that reactive pupils 24 hours after cardiac arrest were associated with improved survival at 180 days with favorable neurologic outcome.[108]

Several serum biomarkers of neurologic injury have been considered for their prognostic value. Two small observational studies found that lower neuron-specific enolase (NSE) and S-100B serum levels post-arrest were associated with improved survival to hospital discharge and improved survival with favorable neurologic outcome.[108,109]

One observational study found that children with lower lactate levels in the first 12 hours after arrest had an improved survival to hospital discharge.[110]

6.3.2 2015 Recommendations - New

EEGs performed within the first 7 days after pediatric cardiac arrest may be considered in prognosticating neurologic outcome at the time of hospital discharge (Class IIb, LOE C-LD) but should not be used as the sole criterion.

The reliability of any 1 variable for prognostication in children after cardiac arrest has not been established.

Practitioners should consider multiple factors when predicting outcomes in infants and children who achieve ROSC after cardiac arrest. (Class I, LOE C-LD)

In situations where children have minimal prospects for recovery, we emphasize the use of multiple variables to inform treatment decisions. Given the greater neuroplasticity and potential for recovery in the developing brain, we place greater value on preserving opportunities for neonatal and pediatric recovery than on limiting therapy based on not-yet-validated prognostic tools. Accordingly, the decision to withdraw life-sustaining therapies is complex and continues to rest with the treating physician and family. Further research in this area is needed.

7 Predicting Neurologic Outcomes in Adult Patients After Cardiac Arrest - Updated

Scientists and clinicians continue to attempt to identify clinical, electrographic, radiographic, and biomarker data, which may be able to prognosticate neurologic outcome in patients. The primary purpose in accurately correlating specific data with poor neurologic outcome is to allow clinicians and families to make informed, but often difficult, choices for a patient who remains comatose after cardiac arrest with subsequent ROSC. There is a growing body of data that correlates specific findings with poor neurologic outcome after cardiac arrest. To date, however, there is no one specific test that can predict with certainty a poor neurologic recovery in this patient population. In making decisions, particularly the decision of whether to continue or withdraw life-sustaining therapies, clinicians and families need the most accurate information possible; typically, this information is an aggregate of clinical, electrographic, radiographic, and laboratory (eg, biomarkers) findings (see "Part 8: Post–Cardiac Arrest Care").

7.1 Timing of Prognostication in Post–Cardiac Arrest Adults - Updated ALS 450   ALS 713

In 2010, it was noted that there are no clinical neurologic signs, electrophysiologic studies, biomarkers, or imaging modalities that can reliably predict death or poor neurologic outcome (eg, Cerebral Performance Category of 3, 4, or 5) within the first 24 hours after cardiac arrest in patients treated with or without TTM. In 1 registry study,[111] it was noted that 63% of patients who survived an IHCA were given a DNAR status, and 43% had medical interventions actively withdrawn. These patients were often young and had no terminal illnesses but experienced death after withdrawal of life support in a time frame that was inadequate to allow thorough examination. This tendency to withdraw interventions prematurely in patients after cardiac arrest may have contributed to a selection bias in the current literature on prognostic testing. As the data are continuing to evolve, it is important to consider the potential for premature withdrawal of life support (see "Part 8: Post–Cardiac Arrest Care").

Sedatives or neuromuscular blockers received during TTM may be metabolized more slowly in patients after cardiac arrest, and injured brains may be more sensitive to the depressant effects of many drugs than normal brains. Residual sedation or paralysis can confound accurate clinical examinations.

7.1.1 2015 Recommendations - Updated

The earliest time for prognostication in patients treated with TTM using clinical examination where sedation or paralysis could be a confounder may be 72 hours after return to normothermia. (Class IIb, LOE C-EO)

We recommend the earliest time to prognosticate a poor neurologic outcome in patients not treated with TTM using clinical examination is 72 hours after cardiac arrest. *(Class I, LOE B-NR)*

This time can be even longer after cardiac arrest if the residual effect of sedation or paralysis confounds the clinical examination. *(Class IIa, LOE C-LD)*

Operationally, the timing for prognostication is typically 4.5 to 5 days after ROSC for patients treated with TTM. This approach minimizes the possibility of obtaining false-positive (ie, erroneously pessimistic) results because of drug-induced depression of neurologic function. In making this recommendation, it is recognized that in some instances, withdrawal of life support may occur appropriately before 72 hours because of underlying terminal disease, brain herniation, or other clearly nonsurvivable situations.

7.2 Prognostic Testing in Adult Patients After Cardiac Arrest - Updated ALS 713   ALS 450

The 2015 systematic evidence reviews examined numerous studies on the diagnostic accuracy of a wide range of tests for patients who did or did not receive TTM therapy.

The 2010 Guidelines recommended clinical examination, electrophysiologic measurements, imagining studies, and blood or cerebrospinal fluid markers of brain injury to estimate the prognosis for neurologic impairment in adult patients who remain comatose after cardiac arrest.[3] Updated guidelines for prognostication have been proposed by other international organizations[112] as well as the AHA in the 2015 Guidelines Update; for further information, see "Part 8: Post–Cardiac Arrest Care."

This topic continues to be an area of active research. The use of TTM has demonstrated the potential to improve the neurologic outcome in certain adult patients after cardiac arrest who might otherwise have a poor neurologic outcome. Although the data and literature are becoming more robust on this particular topic, there are few differences in the types of tests used in those who are and are not treated with TTM as relates to prognosticating neurologic outcome.

7.2.1 2015 Evidence Summary - New

For a full description of the evidence reviewed for each assessment of neurologic function and prognosis for adults who have had cardiac arrest, refer to "Part 8: Post–Cardiac Arrest Care."

7.2.2 2015 Recommendations: Clinical Examination Findings - New

In comatose patients who are not treated with TTM, the absence of pupillary reflex to light at 72 hours or more after cardiac arrest is a reasonable exam finding with which to predict poor neurologic outcome (FPR [false-positive rate], 0%; 95% CI, 0%–8%). *(Class IIa, LOE B-NR)*

In comatose patients who are treated with TTM, the absence of pupillary reflex to light at 72 hours or more after cardiac arrest is useful to predict poor neurologic outcome (FPR, 0%; 95% CI, 0%–3%). *(Class I, LOE B-NR)*

We recommend that, given their high FPRs, the findings of either absent motor movements or extensor posturing should not be used alone for predicting a poor neurologic outcome(FPR, 10%; 95% CI, 7%–15% to FPR, 15%; 95% CI, 5%– 31%). *(Class III: Harm, LOE B-NR)*

The motor examination may be a reasonable means to identify the population who need further prognostic testing to predict poor outcome. *(Class IIb, LOE B-NR)*

We recommend that the presence of myoclonus, which is distinct from status myoclonus, should not be

used to predict poor neurologic outcomes because of the high FPR(FPR, 5%; 95% CI, 3%–8% to FPR, 11%; 95% CI, 3%–26%). *(Class III: Harm, LOE B-NR)*

In combination with other diagnostic tests at 72 or more hours after cardiac arrest, the presence of status myoclonus during the first 72 hours after cardiac arrest is a reasonable finding to help predict poor neurologic outcomes(FPR, 0%; 95% CI, 0%–4%). *(Class IIa, LOE B-NR)*

7.2.3 2015 Recommendations: EEG - Updated ^{ALS 450} ^{ALS 713}

In comatose post–cardiac arrest patients who are treated with TTM, it may be reasonable to consider persistent absence of EEG reactivity to external stimuli at 72 hours after cardiac arrest, and persistent burst suppression on EEG after rewarming, to predict a poor outcome (FPR, 0%; 95% CI, 0%–3%). *(Class IIb, LOE B-NR)*

Intractable and persistent (more than 72 hours) status epilepticus in the absence of EEG reactivity to external stimuli may be reasonable to predict poor outcome. *(Class IIb, LOE B-NR)*

In comatose post–cardiac arrest patients who are not treated with TTM, it may be reasonable to consider the presence of burst suppression on EEG at 72 hours or more after cardiac arrest, in combination with other predictors, to predict a poor neurologic outcome (FPR, 0%; 95% CI, 0%–11%). (Class IIb, LOE B-NR)

7.2.4 2015 Recommendations: Evoked Potentials - Updated ^{ALS 450}

In patients who are comatose after resuscitation from cardiac arrest regardless of treatment with TTM, it is reasonable to consider bilateral absence of the N20 somatosensory evoked potentials (SSEP) wave 24 to 72 hours after cardiac arrest or after rewarming a predictor of poor outcome (FPR, 1%; 95% CI, 0%–3%). (Class IIa, LOE B-NR)

SSEP recording requires appropriate skills and experience, and utmost care should be taken to avoid electrical interference from muscle artifacts or from the intensive care unit environment. However, sedative drugs or temperature manipulation affect SSEPs less than they affect the EEG and clinical examination.[113],[114]

7.2.5 2015 Recommendations: Imaging Tests - New ^{ALS 713}

In patients who are comatose after resuscitation from cardiac arrest and are not treated with TTM, it may be reasonable to use the presence of a marked reduction of the gray-white ratio on brain computed tomography obtained within 2 hours after cardiac arrest to predict poor outcome. (Class IIb, LOE B-NR)

It may be reasonable to consider extensive restriction of diffusion on brain magnetic resonance imaging at 2 to 6 days after cardiac arrest in combination with other established predictors for predicting a poor neurologic outcome. (Class IIb, LOE B-NR)

Note that acquisition and interpretation of imaging studies have not been fully standardized and are affected by interobserver variability.[115] Therefore, brain imaging studies for prognostication should be performed only in centers where specific experience is available.

7.2.6 2015 Recommendations: Blood Markers - Updated ^{ALS 713} ^{ALS 450}

Given the possibility of high FPRs, blood levels of NSE and S-100B should not be used alone to predict a poor neurologic outcome. (Class III: Harm, LOE C-LD)

When performed with other prognostic tests at 72 hours or more after cardiac arrest, it may be reasonable to consider high serum values of NSE at 48 to 72 hours after cardiac arrest to support the prognosis of a poor neurologic outcome (Class IIb, LOE B-NR), especially if repeated sampling reveals persistently high values. (Class IIb, LOE C-LD)

Laboratory standards for NSE and S-100B measurement vary between centers, making comparison of absolute values difficult. The kinetics of these markers have not been studied, particularly during or after TTM in cardiac arrest patients. Finally, NSE and S-100B are not specific to neuronal damage and can be produced by extra–central nervous system sources (hemolysis, neuroendocrine tumors, myenteric plexus, muscle and adipose tissue breakdown). If care is not taken when drawing NSE levels and if multiple time points are not assessed, false-positive results could occur secondary to hemolysis. All of these limitations led the writing group to conclude that NSE should be limited to a confirmatory test rather than a primary method for estimating prognosis.

8 Ethics of Organ and Tissue Donation - Updated

Situations that offer the opportunity for organ donation include donation after neurologic determination of death, controlled donation after circulatory determination of death, and uncontrolled donation after circulatory determination of death. Controlled donation after circulatory death usually takes place in the hospital after a patient whose advanced directives or surrogate, family, and medical team agree to allow natural death and withdraw life support. Uncontrolled donation usually takes place in an emergency department after exhaustive efforts at resuscitation have failed to achieve ROSC. In 2015, the ILCOR Advanced Life Support Task Force reviewed the evidence that might address the question of whether an organ retrieved from a donor who has had CPR that was initially successful (controlled donation) or unsuccessful (uncontrolled donation) would impact survival or complications compared with an organ from a donor who did not require CPR (controlled donation).

8.1 2015 Evidence Summary

Studies comparing transplanted organ function between those organs from donors who had received successful CPR before donation and those whose donors had not received CPR before donation have found no difference in transplanted organ function. This includes immediate graft function, 1-year graft function, and 5-year graft function. Studies have also shown no evidence of worse outcome in transplanted kidneys and livers from adult donors who have not had restoration of circulation after CPR compared with those from other types of donors.[116-119]

8.2 2015 Recommendation - Updated [ALS 449]

We recommend that all patients who are resuscitated from cardiac arrest but who subsequently progress to death or brain death be evaluated for organ donation. (Class I, LOE B-NR)

Patients who do not have ROSC after resuscitation efforts and who would otherwise have termination of efforts may be considered candidates for kidney or liver donation in settings where programs exist. (Class IIb, LOE B-NR)

In making this recommendation, the decisions for termination of resuscitative efforts and the pursuit of organ donation need to be independent processes (see "Part 8: Post–Cardiac Arrest Care").

In 2010, it was noted that most communities do not optimize the retrieval of organ and tissue donations; this has created protracted waiting time and greater suffering for patients awaiting organ transplantation. The Emergency Cardiovascular Care community of the American Heart Association supports efforts to optimize the ethical acquisition of organ and tissue donations. Studies suggest no difference in functional outcomes of organs transplanted from patients who are determined to be brain dead as a consequence of cardiac arrest when

compared with donors who are brain dead from other causes.[120-123]

Therefore it is reasonable to suggest that all communities should optimize retrieval of tissue and organ donations in brain dead post–cardiac arrest patients (in-hospital) and those pronounced dead in the out-of-hospital setting. (Class IIa, LOE B)

Most important to this process is advance planning and infrastructure support to allow organ donation to occur in a manner sensitive to the needs of the donor's family and without undue burden on the staff.

Medical directors of EMS agencies, emergency departments (EDs), and critical care units (CCUs) should develop protocols and implementation plans with the regional organ and tissue donation program to optimize donation following a cardiac arrest death (Class I, LOE C), including:

A process by which permission for organ and tissue donations will be obtained
The establishment of clearly defined guidelines for organ and tissue procurement that will be available to all healthcare providers both in and out of the hospital
Information to address the possible differences between applicable laws and societal values in procedures for organ procurement
The emotional support to be offered to providers post event
A system to acquire organ and tissue donations from individuals pronounced dead in the out-of-hospital setting. This discussion should include input from the coroner, EMS, police, and lay people representing the target community

The 2010 Guidelines outlined the debate regarding the ethics of organ donation.[124] The debate continues today. Points to consider are outlined in **Table 1** below, with opposing viewpoints on the issue.[125-132] Although this material was not reviewed as part of the ILCOR review process, this section is intended to highlight some of the ethical issues around organ donation. A full discussion of the merits of each of these viewpoints is beyond the scope of this publication.

Table 1: 2015 - Ethical Questions and Issues Surrounding Organ Donation

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Ethical Questions and Issues Surrounding Organ Donation		
Ethical Question	**Viewpoint**	**Alternative Viewpoint**
How long after loss of circulation can a practitioner declare death?	Between 2 and 10 minutes, based on current literature documenting length of time that autoresuscitation has occurred, as long as the decision to allow natural death has been made.	Not until the point in time that resuscitative efforts could not restore spontaneous circulation. Currently we do not have evidence to support how long this would be.
	Between 7 and 10 minutes after resuscitative efforts have stopped in uncontrolled donation after circulatory determination of death.	

Ethical Question	Viewpoint	Alternative Viewpoint
Are individuals and surrogates truly and fully informed when consenting for organ donation?	Individuals may consent by designating the decision on a driver's license, in advance directives and wills, or through an online donor registry. If no previous consent by a patient exists, a surrogate will usually have to give consent if the patient is unable.	Individuals who consent to organ donation may not understand the dying process or be aware of the ethical dilemmas involved in organ donation.
Are there conflicts of interest?	Organ donation should not be considered until the decision has been made to allow natural death and withdraw support.	There is perception that those who care for patients and participate in withdrawal decisions are providers who care for organ recipients and may be biased.
	Organ procurement teams and transplant surgeons are not to be involved in the decisions or act of withdrawing support or declaring death.	
	Consent for donation should be requested by a trained individual who is not part of the care team.	Some believe that it is impossible to not consider organ donation as decisions to withdraw care are being made and, therefore, could influence the decision to withdraw support.
Should antemortem interventions be performed (eg, administration of heparin, vasodilators, bronchoscopy, cannulating large vessels—all for the purpose of preserving organ function)?	If the actual risk to the donor is low and is fully disclosed to patients and families, the procedure is ethically acceptable.	There is concern that these procedures pose risks to the donor and benefit only the recipient.
What postmortem procedures are ethically acceptable (eg, procedures such as extracorporeal membrane oxygenation that restore circulation and oxygenation)?	Restoring circulation to organs can result in better outcomes of transplanted organs. As long as oxygen and circulation are not supplied to the brain by the procedure, the diagnosis of death is still valid.	Procedures that restore oxygenation and circulation are unacceptable because they could reverse death.

9 Summary - Updated

Managing the multiple decisions associated with resuscitation is challenging from many perspectives, and no more so than when healthcare providers are dealing with the ethics surrounding decisions to provide or withhold emergency cardiovascular care. This is especially true with the increasing availability of technologies that hold the promise of improved outcomes after cardiac arrest, such as ECPR and TTM.

In the 2015 Guidelines Update, we have provided the evidence identified by 7 systematic reviews and the clarifying language to several other topics that were covered in the 2010 systematic review process but were not subjected to a full evidence review in 2015.

There is often insufficient evidence to recommend for or against specific interventions due to the uncertainty of determining a prognosis and predicting a particular outcome. As such, a solid understanding of the ethical principles surrounding autonomy and decision making must be coupled with the best information available at the time. Beyond decisions regarding the initiation and termination of life support, family presence during

resuscitations and organ donation also require healthcare providers to consider both science and ethics when providing patient-centered care.

As the science that informs resuscitation efforts continues to advance, so too must our efforts to understand the ethical implications that accompany them.

10 Authorship and Disclosures

10.1 2015 Writing Team

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Table 2: Part 3: Ethical Issues: 2015 Guidelines Update Writing Group Disclosures

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Part 3: Ethical Issues: 2015 Guidelines Update Writing Group Disclosures							
Writing Group Member	**Employment**	**Research Grant**	**Other Research Support**	**Speakers' Bureau/ Honoraria**	**Expert Witness**	**Ownership Interest**	**Consultant/Advis Board**	**Other**
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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition. *Modest. †Significant.

10.2 2010 Writing Team

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Table 3: 2010 - Guidelines Part 3: Ethics: Writing Group Disclosures

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2010 Guidelines Part 3: Ethics: Writing Group Disclosures

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Ahamed H. Idris	UT Southwestern Medical Center at Dallas–Profess of Surgery	†NIH grant for the Resuscitation Outcomes Consortium Dallas-Fort Worth Site. I serve as the site PI. All payments to UT SWMC, at which I'm employed	*In kind support from Philips, Medtronics, and ZOLL consisting of defibrillators, software, and manikins used for training purposes	None	None	None	None
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Writing Group Member	Employment	Research Grant	Other Research Support	Speakers' Bureau/Honoraria	Ownership Interest	Consultant/Advisory Board	Other
• This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.							
• ?* Modest.							
• ?† Significant.							

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11 Footnotes

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References

1. Guru V, Verbeek PR, Morrison LJ. Response of paramedics to terminally ill patients with cardiac arrest: an ethical dilemma. CMAJ. 1999;161:1251–1254.

2. Wiese CH, Bartels UE, Zausig YA, Pfirstinger J, Graf BM, Hanekop GG. Prehospital emergency treatment of palliative care patients with cardiac arrest: a retrolective investigation. Support Care Cancer. 2010;18:1287–1292. doi: 10.1007/s00520-009-0746-8.

3. Miller W, Levy P, Lamba S, Zalenski RJ, Compton S. Descriptive analysis of the in-hospital course of patients who initially survive out-of-hospital cardiac arrest but die in-hospital. J Palliat Med. 2010;13:19–22. doi: 10.1089/jpm.2009.0248.

4. Morrison LJ, Kierzek G, Diekema DS, Sayre MR, Silvers SM, Idris AH, Mancini ME. Part 3: ethics: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122(suppl 3):S665–S675. doi: 10.1161/ CIRCULATIONAHA.110.970905.

5. Beauchamp TL, Childress J. Principles of Biomedical Ethics. Oxford, England: Oxford University Press; 2008.

6. Simon JR. Refusal of care: the physician-patient relationship and decisionmaking capacity. Ann Emerg Med. 2007;50:456–461. doi: 10.1016/j. annemergmed.2007.04.016.

7. Wright AA, Zhang B, Ray A, Mack JW, Trice E, Balboni T, Mitchell SL, Jackson VA, Block SD, Maciejewski PK, Prigerson HG. Associations between end-of-life discussions, patient mental health, medical care near death, and caregiver bereavement adjustment. JAMA. 2008;300:1665–1673.

8. Omnibus Budget Reconciliation Act of 1990, Pub. Law No. 1990;101–508.

9. Silveira MJ, Kim SY, Langa KM. Advance directives and outcomes of surrogate decision making before death. N Engl J Med. 2010;362:1211–1218.

10. Cerminara KL, Bogin SM. A paper about a piece of paper. Regulatory action as the most effective way to promote use of physician orders for life-sustaining treatment. J Leg Med. 2008;29:479–503.

11. Payne JK, Thornlow DK. Clinical perspectives on portable do-not-resuscitate orders. J Gerontol Nurs. 2008;34:11–16.

12. Venneman SS, Narnor-Harris P, Perish M, Hamilton M. "Allow natural death" versus "do not resuscitate": three words that can change a life. J Med Ethics. 2008;34:2–6.

13. Schneiderman LJ, Jecker NS, Jonsen AR. Medical futility: its meaning and ethical implications. Ann Intern Med. 1990;112:949–954.

14. Hickman SE, Keevern E, Hammes BJ. Use of the physician orders for life-sustaining treatment program in the clinical setting: a systematic review of the literature. J Am Geriatr Soc. 2015;63:341–350. doi: 10.1111/ jgs.13248.

15. Sherbino J, Guru V, Verbeek PR, Morrison LJ. Prehospital emergency medical services. CJEM. 2000;2:246–251.

16. Kellermann A, Lynn J. Withholding resuscitation in prehospital care. Ann Intern Med. 2006;144:692–693.

17. Feder S, Matheny RL, Loveless RS Jr., Rea TD. Withholding resuscitation: a new approach to prehospital end-of-life decisions. Ann Intern Med. 2006;144:634–640.

18. Avalli L, Maggioni E, Formica F, Redaelli G, Migliari M, Scanziani M, Celotti S, Coppo A, Caruso R, Ristagno G, Fumagalli R. Favourable sur- vival of in-hospital compared to out-of-hospital refractory cardiac arrest patients treated with extracorporeal membrane oxygenation: an Italian tertiary care centre experience. Resuscitation. 2012;83:579–583. doi: 10.1016/j.resuscitation.2011.10.013.

19. Wolf MJ, Kanter KR, Kirshbom PM, Kogon BE, Wagoner SF. Extracorporeal cardiopulmonary resuscitation for pediatric cardiac patients. Ann Thorac Surg. 2012;94:874–879; discussion 879. doi: 10.1016/j.athoracsur.2012.04.040.

20. Delmo Walter EM, Alexi-Meskishvili V, Huebler M, Redlin M, Boettcher W, Weng Y, Berger F, Hetzer R. Rescue extracorporeal membrane oxy- genation in children with refractory cardiac arrest. Interact Cardiovasc Thorac Surg. 2011;12:929–934. doi: 10.1510/icvts.2010.254193.

21. Morrison LJ, Visentin LM, Kiss A, Theriault R, Eby D, Vermeulen M, Sherbino J, Verbeek PR. Validation of a rule for termination of resuscitation in out-of-hospital cardiac arrest. N Engl J Med. 2006;355:478–487.

22. Richman PB, Vadeboncoeur TF, Chikani V, Clark L, Bobrow BJ. Independent evaluation of an out-of-hospital termination of resuscitation (TOR) clinical decision rule. Acad Emerg Med. 2008;15:517–521.

23. Morrison LJ, Verbeek PR, Zhan C, Kiss A, Allan KS. Validation of a universal prehospital termination of resuscitation clinical prediction rule for advanced and basic life support providers. Resuscitation. 2009;80:324–328.

24. Ong ME, Jaffey J, Stiell I, Nesbitt L. Comparison of termination-of-resuscitation guidelines for basic life support: defibrillator providers in out-of-hospital cardiac arrest. Ann Emerg Med. 2006;47:337–343.

25. Sasson C, Hegg AJ, Macy M, Park A, Kellermann A, McNally B. Prehospital termination of resuscitation in cases of refractory out-of-hospital cardiac arrest. JAMA. 2008;300:1432–1438.

26. Ruygrok ML, Byyny RL, Haukoos JS. Validation of 3 termination of resuscitation criteria for good neurologic survival after out-of-hospital cardiac arrest. Ann Emerg Med. 2009;54:239–247.

27. Skrifvars MB, Vayrynen T, Kuisma M, Castren M, Parr MJ, Silfverstople J, Svensson L, Jonsson L, Herlitz J. Comparison of Helsinki and European Resuscitation Council "do not attempt to resuscitate" guidelines, and a termination of resuscitation clinical prediction rule for out-of-hospital cardiac arrest patients found in asystole or pulseless electrical activity. Resuscitation. 2010.

28. Verbeek PR, Vermeulen MJ, Ali FH, Messenger DW, Summers J, Morrison LJ. Derivation of a termination-of-resuscitation guideline for emergency medical technicians using automated external defibrillators. Acad Emerg Med. 2002;9:671–678.

29. Morrison LJ, Visentin LM, Vermeulen M, Kiss A, Theriault R, Eby D, Sherbino J, Verbeek R. Inter-rater reliability and comfort in the application of a basic life support termination of resuscitation clinical prediction rule for out of hospital cardiac arrest. Resuscitation. 2007;74:150–157.

30. Bailey ED, Wydro GC, Cone DC. Termination of resuscitation in the prehospital setting for adult patients suffering nontraumatic cardiac arrest. National Association of EMS Physicians Standards and Clinical Practice Committee. Prehosp Emerg Care. 2000;4:190–195.

31. Morrison LJ, Verbeek PR, Vermeulen MJ, Kiss A, Allan KS, Nesbitt L, Stiell I. Derivation and evaluation of a termination of resuscitation clinical prediction rule for advanced life support providers. Resuscitation. 2007;74:266–275.

32. Auerbach PS, Morris JA Jr., Phillips JB Jr., Redlinger SR, Vaughn WK. An analysis of ambulance accidents in Tennessee. JAMA. 1987;258:1487–1490.

33. Kellermann AL, Hackman BB. Terminating unsuccessful advanced cardiac life support in the field. Am J Emerg Med. 1987;5:548–549.

34.

Morrison LJ, Cheung MC, Redelmeier DA. Evaluating paramedic comfort with field pronouncement: development and validation of an outcome measure. Acad Emerg Med. 2003;10:633–637.

35. Gray WA, Capone RJ, Most AS. Unsuccessful emergency medical resuscitation: are continued efforts in the emergency department justified? N Engl J Med. 1991;325:1393–1398.

36. Suchard JR, Fenton FR, Powers RD. Medicare expenditures on unsuccessful out-of-hospital resuscitations. J Emerg Med. 1999;17:801–805.

37. Olasveengen TM, Wik L, Steen PA. Quality of cardiopulmonary resuscitation before and during transport in out-of-hospital cardiac arrest. Resuscitation. 2008;76:185–190.

38. Eisenberg MS, Mengert TJ. Cardiac resuscitation. N Engl J Med. 2001;344:1304–1313.

39. Chung TN, Kim SW, Cho YS, Chung SP, Park I, Kim SH. Effect of vehicle speed on the quality of closed-chest compression during ambulance transport. Resuscitation. 2010.

40. Maekawa K, Tanno K, Hase M, Mori K, Asai Y. Extracorporeal cardiopulmonary resuscitation for patients with out-of-hospital cardiac arrest of cardiac origin: a propensity-matched study and pre- dictor analysis. Crit Care Med. 2013;41:1186–1196. doi: 10.1097/ CCM.0b013e31827ca4c8.

41. Sakamoto T, Morimura N, Nagao K, Asai Y, Yokota H, Nara S, Hase M, Tahara Y, Atsumi T; SAVE-J Study Group. Extracorporeal cardio- pulmonary resuscitation versus conventional cardiopulmonary resus- citation in adults with out-of-hospital cardiac arrest: a prospective observational study. Resuscitation. 2014;85:762–768. doi: 10.1016/j. resuscitation.2014.01.031.

42. Atkins DL, Everson-Stewart S, Sears GK, Daya M, Osmond MH, Warden CR, Berg RA; Resuscitation Outcomes Consortium Investigators. Epidemiology and outcomes from out-of-hospital cardiac arrest in children: the Resuscitation Outcomes Consortium Epistry- Cardiac Arrest. Circulation. 2009;119:1484–1491. doi: 10.1161/ CIRCULATIONAHA.108.802678.

43. Kitamura T, Iwami T, Kawamura T, Nagao K, Tanaka H, Nadkarni VM, Berg RA, Hiraide A; implementation working group for All-Japan Utstein Registry of the Fire and Disaster Management Agency. Conventional and chest-compression-only cardiopulmonary resuscitation by bystanders for children who have out-of-hospital cardiac arrests: a prospective, nation- wide, population-based cohort study. Lancet. 2010;375:1347–1354. doi: 10.1016/S0140-6736(10)60064-5.

44. YoungKD,Gausche-HillM,McClungCD,LewisRJ.Aprospective,pop- ulation-based study of the epidemiology and outcome of out-of-hospital pediatric cardiopulmonary arrest. Pediatrics. 2004;114:157–164.

45. Moler FW, Donaldson AE, Meert K, Brilli RJ, Nadkarni V, Shaffner DH, Schleien CL, Clark RS, Dalton HJ, Statler K, Tieves KS, Hackbarth R, Pretzlaff R, van der Jagt EW, Pineda J, Hernan L, Dean JM; Pediatric Emergency Care Applied Research Network. Multicenter cohort study of out-of-hospital pediatric cardiac arrest. Crit Care Med. 2011;39:141–149. doi: 10.1097/CCM.0b013e3181fa3c17.

46. López-Herce J, García C, Domínguez P, Rodríguez-Núñez A, Carrillo A, Calvo C, Delgado MA; Spanish Study Group of Cardiopulmonary Arrest in Children. Outcome of out-of-hospital cardiorespiratory arrest in children. Pediatr Emerg Care. 2005;21:807–815.

47. Loertscher L, Reed DA, Bannon MP, Mueller PS. Cardiopulmonary resuscitation and do-not-resuscitate orders: a guide for clinicians. Am J Med. 2010;123:4–9.

48. Do Not Attempt Resuscitation (DNAR) Decisions in the Perioperative Period. London: The Association of Anaesthetists of Great Britain and Ireland; 2009.

49. Field JM, Hazinski MF, Sayre MR, Chameides L, Schexnayder SM, Hemphill R, Samson RA, Kattwinkel J, Berg RA, Bhanji F, Cave DM, Jauch EC, Kudenchuk PJ, Neumar RW, Peberdy MA, Perlman JM, Sinz E, Travers AH, Berg MD, Billi JE, Eigel B, Hickey RW, Kleinman ME, Link MS, Morrison LJ, O'Connor RE, Shuster M, Callaway CW, Cucchiara B, Ferguson JD, Rea TD, Vanden Hoek TL. Part 1: executive summary: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122(suppl 3):S640–S656. doi: 10.1161/CIRCULATIONAHA.110.970889.

50. Bottoms SF, Paul RH, Mercer BM, MacPherson CA, Caritis SN, Moawad AH, Van Dorsten JP, Hauth JC, Thurnau GR, Miodovnik M, Meis PM, Roberts JM, McNellis D, Iams JD. Obstetric determinants of neonatal survival: antenatal predictors of neonatal survival and mor- bidity in extremely low birth weight infants. Am J Obstet Gynecol. 1999;180(3 pt 1):665–669.

51. Ambalavanan N, Carlo WA, Bobashev G, Mathias E, Liu B, Poole K, Fanaroff AA, Stoll BJ, Ehrenkranz R, Wright LL; National Institute of Child Health and Human Development Neonatal Research Network. Prediction of death for extremely low birth weight neonates. Pediatrics. 2005;116:1367–1373. doi: 10.1542/peds.2004-2099.

52. Manktelow BN, Seaton SE, Field DJ, Draper ES. Population-based estimates of in-unit survival for very preterm infants. Pediatrics. 2013;131:e425–e432. doi: 10.1542/peds.2012-2189.

53. Medlock S, Ravelli AC, Tamminga P, Mol BW, Abu-Hanna A. Prediction of mortality in very premature infants: a systematic review of prediction models. PLoS One. 2011;6:e23441. doi: 10.1371/journal.pone.0023441.

54. Patel H, Beeby PJ. Resuscitation beyond 10 minutes of term babies born without signs of life. J Paediatr Child Health. 2004;40:136–138.

55. Tyson JE, Parikh NA, Langer J, Green C, Higgins RD; National Institute of Child Health and Human Development Neonatal Research Network. Intensive care for extreme prematurity–moving beyond gestational age. N Engl J Med. 2008;358:1672–1681. doi: 10.1056/NEJMoa073059.

56. Paris JJ. What standards apply to resuscitation at the borderline of gestational age? J Perinatol. 2005;25:683–684.

57. De Leeuw R, Cuttini M, Nadai M, Berbik I, Hansen G, Kucinskas A, Lenoir S, Levin A, Persson J, Rebagliato M, Reid M, Schroell M, de Vonderweid U. Treatment choices for extremely preterm infants: an international perspective. J Pediatr. 2000;137:608–616.

58. Casalaz DM, Marlow N, Speidel BD. Outcome of resuscitation follow- ing unexpected apparent stillbirth. Arch Dis Child Fetal Neonatal Ed. 1998;78:F112–F115.

59. Harrington DJ, Redman CW, Moulden M, Greenwood CE. The long-term outcome in surviving infants with Apgar zero at 10 minutes: a systematic review of the literature and hospital-based cohort. Am J Obstet Gynecol. 2007;196:463.e1–463.e5. doi: 10.1016/j.ajog.2006.10.877.

60. Kasdorf E, Laptook A, Azzopardi D, Jacobs S, Perlman JM. Improving infant outcome with a 10 min Apgar of 0. Arch Dis Child Fetal Neonatal Ed. 2015;100:F102–F105. doi: 10.1136/archdischild-2014-306687.

61. Laptook AR, Shankaran S, Ambalavanan N, Carlo WA, McDonald SA, Higgins RD, Das A; Hypothermia Subcommittee of the NICHD Neonatal Research Network. Outcome of term infants using apgar scores at 10 minutes following hypoxic-ischemic encephalopathy. Pediatrics. 2009;124:1619–1626. doi: 10.1542/peds.2009-0934.

62. Sarkar S, Bhagat I, Dechert RE, Barks JD. Predicting death despite thera- peutic hypothermia in infants with hypoxic-ischaemic encephalopathy. Arch Dis Child Fetal Neonatal Ed. 2010;95:F423–F428. doi: 10.1136/ adc.2010.182725.

63. Chen YS, Lin JW, Yu HY, Ko WJ, Jerng JS, Chang WT, Chen WJ, Huang SC, Chi NH, Wang CH, Chen LC, Tsai PR, Wang SS, Hwang JJ, Lin FY. Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in- hospital cardiac arrest: an observational study and propensity analysis. Lancet. 2008;372:554–561. doi: 10.1016/S0140-6736(08)60958-7.

64. Lin JW, Wang MJ, Yu HY, Wang CH, Chang WT, Jerng JS, Huang SC, Chou NK, Chi NH, Ko WJ, Wang YC, Wang SS, Hwang JJ, Lin FY, Chen YS. Comparing the survival between extracorporeal rescue and conven- tional resuscitation in adult in-hospital cardiac arrests: propensity analy- sis of three-year data. Resuscitation. 2010;81:796–803. doi: 10.1016/j. resuscitation.2010.03.002.

65. Shin TG, Choi JH, Jo IJ, Sim MS, Song HG, Jeong YK, Song YB, Hahn JY, Choi SH, Gwon HC, Jeon ES, Sung K, Kim WS, Lee YT. Extracorporeal cardiopulmonary resuscitation in patients with inhospital cardiac arrest: A comparison with conventional cardiopulmonary resuscitation. Crit Care Med. 2011;39:1–7. doi: 10.1097/CCM.0b013e3181feb339.

66. Wu ET, Li MJ, Huang SC, Wang CC, Liu YP, Lu FL, Ko WJ, Wang MJ, Wang JK, Wu MH. Survey of outcome of CPR in pediatric in- hospital car- diac arrest in a medical center in Taiwan. Resuscitation. 2009;80:443–448. doi: 10.1016/j.resuscitation.2009.01.006.

67. Moler FW, Meert K, Donaldson AE, Nadkarni V, Brilli RJ, Dalton HJ, Clark RS, Shaffner DH, Schleien CL, Statler K, Tieves KS, Hackbarth R, Pretzlaff R, van der Jagt EW, Levy F, Hernan L, Silverstein FS, Dean JM; Pediatric Emergency Care Applied Research Network. In-hospital versus out-of-hospital pediatric cardiac arrest: a multicenter cohort study. Crit Care Med. 2009;37:2259–2267. doi: 10.1097/CCM.0b013e3181a00a6a.

68. de Mos N, van Litsenburg RR, McCrindle B, Bohn DJ, Parshuram CS. Pediatric in-intensive-care-unit cardiac arrest: incidence, survival, and predictive factors. Crit Care Med. 2006;34:1209–1215. doi: 10.1097/01. CCM.0000208440.66756.C2.

69. Lowry AW, Morales DL, Graves DE, Knudson JD, Shamszad P, Mott AR, Cabrera AG, Rossano JW. Characterization of extracorporeal membrane oxygenation for pediatric cardiac arrest in the United States: analysis of the kids' inpatient database. Pediatr Cardiol. 2013;34:1422–1430. doi: 10.1007/s00246-013-0666-8.

70. Odegard KC, Bergersen L, Thiagarajan R, Clark L, Shukla A, Wypij D, Laussen PC. The frequency of cardiac arrests in patients with con- genital heart disease undergoing cardiac catheterization. Anesth Analg. 2014;118:175–182. doi: 10.1213/ANE.0b013e3182908bcb.

71. Ortmann L, Prodhan P, Gossett J, Schexnayder S, Berg R, Nadkarni V, Bhutta A; American Heart Association's Get With the Guidelines– Resuscitation Investigators. Outcomes after in-hospital cardiac arrest in children with cardiac disease: a report from Get With the Guidelines– Resuscitation. Circulation. 2011;124:2329–2337. doi: 10.1161/ CIRCULATIONAHA.110.013466.

72. Matos RI, Watson RS, Nadkarni VM, Huang HH, Berg RA, Meaney PA, Carroll CL, Berens RJ, Praestgaard A, Weissfeld L, Spinella PC; American Heart Association's Get With The Guidelines–Resuscitation (Formerly the National Registry of Cardiopulmonary Resuscitation) Investigators. Duration of cardiopulmonary resuscitation and illness category impact survival and neurologic outcomes for in-hospital pedi- atric cardiac arrests. Circulation. 2013;127:442–451. doi: 10.1161/ CIRCULATIONAHA.112.125625.

73. Reis AG, Nadkarni V, Perondi MB, Grisi S, Berg RA. A prospective investigation into the epidemiology of in-hospital pediatric cardiopulmonary resuscitation using the international Utstein reporting style. Pediatrics. 2002;109:200–209.

74. Haque A, Rizvi A, Bano S. Outcome of in-hospital pediatric cardiopulmonary arrest from a single center in Pakistan. Indian J Pediatr. 2011;78:1356–1360. doi: 10.1007/s12098-011-0439-4.

75. Meert KL, Donaldson A, Nadkarni V, Tieves KS, Schleien CL, Brilli RJ, Clark RS, Shaffner DH, Levy F, Statler K, Dalton HJ, van der Jagt EW, Hackbarth R, Pretzlaff R, Hernan L, Dean JM, Moler FW; Pediatric Emergency Care Applied Research Network. Multicenter cohort study of in-hospital pediatric cardiac arrest. Pediatr Crit Care Med. 2009;10:544– 553. doi: 10.1097/PCC.0b013e3181a7045c.

76. López-Herce J, Del Castillo J, Matamoros M, Cañadas S, Rodriguez- Calvo A, Cecchetti C, Rodriguez-Núñez A, Alvarez AC; Iberoamerican Pediatric Cardiac Arrest Study Network RIBEPCI. Factors associated with mortality in pediatric in-hospital cardiac arrest: a prospective multicenter multinational observational study. Intensive Care Med. 2013;39:309–318. doi: 10.1007/s00134-012-2709-7.

77. Tibballs J, Kinney S. A prospective study of outcome of in-patient pae- diatric cardiopulmonary arrest. Resuscitation. 2006;71:310–318. doi: 10.1016/j.resuscitation.2006.05.009.

78. Ahrens T, Schallom L, Bettorf K, Ellner S, Hurt G, O'Mara V, Ludwig J, George W, Marino T, Shannon W. End-tidal carbon dioxide measurements as a prognostic indicator of outcome in cardiac arrest. Am J Crit Care. 2001;10:391–398.

79. Callaham M, Barton C. Prediction of outcome of cardiopulmonary resus- citation from end-tidal carbon dioxide concentration. Crit Care Med. 1990;18:358–362.

80. Cantineau JP, Lambert Y, Merckx P, Reynaud P, Porte F, Bertrand C, Duvaldestin P. End-tidal carbon dioxide during cardiopulmonary resusci- tation in humans presenting mostly with asystole: a predictor of outcome. Crit Care Med. 1996;24:791–796.

81. Levine RL, Wayne MA, Miller CC. End-tidal carbon dioxide and outcome of out-of-hospital cardiac arrest. N Engl J Med. 1997;337:301–306. doi: 10.1056/NEJM199707313370503.

82. Wayne MA, Levine RL, Miller CC. Use of end-tidal carbon diox- ide to predict outcome in prehospital cardiac arrest. Ann Emerg Med. 1995;25:762–767.

83. Meyers TA, Eichhorn DJ, Guzzetta CE. Do families want to be present during CPR? A retrospective survey. J Emerg Nurs. 1998;24:400–405.

84. Robinson SM, Mackenzie-Ross S, Campbell Hewson GL, Egleston CV, Prevost AT. Psychological effect of witnessed resuscitation on bereaved relatives. Lancet. 1998;352:614–617.

85. Boie ET, Moore GP, Brummett C, Nelson DR. Do parents want to be present during invasive procedures performed on their children in the emergency department? A survey of 400 parents. Ann Emerg Med. 1999;34:70–74.

86. Adams S, Whitlock M, Higgs R, Bloomfield P, Baskett PJ. Should relatives be allowed to watch resuscitation? BMJ. 1994;308:1687–1692.

87. Boyd R. Witnessed resuscitation by relatives. Resuscitation. 2000;43:171–176.

88. Hampe SO. Needs of the grieving spouse in a hospital setting. Nurs Res. 1975;24:113–120.

89. Offord RJ. Should relatives of patients with cardiac arrest be invited to be present during cardiopulmonary resuscitation? Intensive Crit Care Nurs. 1998;14:288–293.

90. Shaner K, Eckle N. Implementing a program to support the option of family presence during resuscitation. The Association for the Care of Children's Health (ACCH) Advocate. 1997;3:3–7.

91. Eichhorn DJ, Meyers TA, Mitchell TG, Guzzetta CE. Opening the doors: family presence during resuscitation. J Cardiovasc Nurs. 1996;10:59–70.

92. Doyle CJ, Post H, Burney RE, Maino J, Keefe M, Rhee KJ. Family participation during resuscitation: an option. Ann Emerg Med. 1987;16:673–675.

93. Barratt F, Wallis DN. Relatives in the resuscitation room: their point of view. J Accid Emerg Med. 1998;15:109–111.

94. Compton S, Madgy A, Goldstein M, Sandhu J, Dunne R, Swor R. Emergency medical service providers' experience with family presence during cardiopulmonary resuscitation. Resuscitation. 2006;70:223–228.

95. Beckman AW, Sloan BK, Moore GP, Cordell WH, Brizendine EJ, Boie ET, Knoop KJ, Goldman MJ, Geninatti MR. Should parents be present during emergency department procedures on children, and who should make that decision? A survey of emergency physician and nurse attitudes. Acad Emerg Med. 2002;9:154–158.

96. Dudley NC, Hansen KW, Furnival RA, Donaldson AE, Van Wagenen KL, Scaife ER. The effect of family presence on the efficiency of pediatric trauma resuscitations. Ann Emerg Med. 2009;53:777–784. e773.

97.

Tinsley C, Hill JB, Shah J, Zimmerman G, Wilson M, Freier K, Abd-Allah S, Tinsley C, Hill JB, Shah J, Zimmerman G, Wilson M, Freier K, Abd-Allah S. Experience of families during cardiopulmonary resuscitation in a pediatric intensive care unit. Pediatrics. 2008;122:e799–e804.

98. Mangurten J, Scott SH, Guzzetta CE, Clark AP, Vinson L, Sperry J, Hicks B, Voelmeck W. Effects of family presence during resuscitation and invasive procedures in a pediatric emergency department. Journal of Emergency Nursing. 2006;32:225–233.

99. McGahey-Oakland PR, Lieder HS, Young A, Jefferson LS, McGahey-Oakland PR, Lieder HS, Young A, Jefferson LS. Family experiences during resuscitation at a children's hospital emergency department. Journal of Pediatric Health Care. 2007;21:217–225.

100. Jones M, Qazi M, Young KD. Ethnic differences in parent preference to be present for painful medical procedures. Pediatrics. 2005;116:e191–e197.

101. Andrews R, Andrews R. Family presence during a failed major trauma resuscitation attempt of a 15-year-old boy: lessons learned.[see comment]. Journal of Emergency Nursing. 2004;30:556–558.

102. Dill K, Gance-Cleveland B, Dill K, Gance-Cleveland B. With you until the end: family presence during failed resuscitation. Journal for Specialists in Pediatric Nursing: JSPN. 2005;10:204–207.

103. Gold KJ, Gorenflo DW, Schwenk TL, Bratton SL, Gold KJ, Gorenflo DW, Schwenk TL, Bratton SL. Physician experience with family presence during cardiopulmonary resuscitation in children. [see comment]. Pediatric Crit Care Med. 2006;7:428–433.

104. Duran CR, Oman KS, Abel JJ, Koziel VM, Szymanski D. Attitudes Toward and Beliefs About Family Presence: A Survey of Healthcare Providers, Patients' Families, and Patients. Am Journal of Critical Care. 2007;16:270–279.

105. Iserson KV. Notifying survivors about sudden, unexpected deaths. West J Med. 2000;173:261–265.

106. Kessler SK, Topjian AA, Gutierrez-Colina AM, Ichord RN, Donnelly M, Nadkarni VM, Berg RA, Dlugos DJ, Clancy RR, Abend NS. Short-term outcome prediction by electroencephalographic features in children treated with therapeutic hypothermia after cardiac arrest. Neurocrit Care. 2011;14:37–43. doi: 10.1007/s12028-010-9450-2.

107. Nishisaki A, Sullivan J 3rd, Steger B, Bayer CR, Dlugos D, Lin R, Ichord R, Helfaer MA, Nadkarni V. Retrospective analysis of the prognostic value of electroencephalography patterns obtained in pediatric in-hospital cardiac arrest survivors during three years. Pediatr Crit Care Med. 2007;8:10–17. doi: 10.1097/01.pcc.0000256621.63135.4b.

108. Abend NS, Topjian AA, Kessler SK, Gutierrez-Colina AM, Berg RA, Nadkarni V, Dlugos DJ, Clancy RR, Ichord RN. Outcome prediction by motor and pupillary responses in children treated with therapeutic hypo- thermia after cardiac arrest. Pediatr Crit Care Med. 2012;13:32–38. doi: 10.1097/PCC.0b013e3182196a7b.

109. Fink EL, Berger RP, Clark RS, Watson RS, Angus DC, Richichi R, Panigrahy A, Callaway CW, Bell MJ, Kochanek PM. Serum biomarkers of brain injury to classify outcome after pediatric cardiac arrest. Crit Care Med. 2014;42:664–674. doi: 10.1097/01.ccm.0000435668.53188.80.

110. Topjian AA, Lin R, Morris MC, Ichord R, Drott H, Bayer CR, Helfaer MA, Nadkarni V. Neuron-specific enolase and S-100B are associated with neurologic outcome after pediatric cardiac arrest. Pediatr Crit Care Med. 2009;10:479–490. doi: 10.1097/PCC.0b013e318198bdb5.

111. Topjian AA, Clark AE, Casper TC, Berger JT, Schleien CL, Dean JM, Moler FW; Pediatric Emergency Care Applied Research Network. Early lactate elevations following resuscitation from pediatric cardiac arrest are associated with increased mortality. Pediatr Crit Care Med. 2013;14:e380–e387. doi: 10.1097/PCC.0b013e3182976402.

112. Peberdy MA, Ornato JP. Post-resuscitation care: is it the missing link in the Chain of Survival? Resuscitation. 2005;64:135–137. doi: 10.1016/j. resuscitation.2004.09.015.

113. Sandroni C, Cariou A, Cavallaro F, Cronberg T, Friberg H, Hoedemaekers C, Horn J, Nolan JP, Rossetti AO, Soar J. Prognostication in coma- tose survivors of cardiac arrest: an advisory statement from the European Resuscitation Council and the European Society of Intensive Care Medicine. Resuscitation. 2014;85:1779–1789. doi: 10.1016/j. resuscitation.2014.08.011.

114. Tiainen M, Kovala TT, Takkunen OS, Roine RO. Somatosensory and brainstem auditory evoked potentials in cardiac arrest patients treated with hypothermia. Crit Care Med. 2005;33:1736–1740.

115. Kottenberg-Assenmacher E, Armbruster W, Bornfeld N, Peters J. Hypothermia does not alter somatosensory evoked potential amplitude and global cerebral oxygen extraction during marked sodium nitroprus- side-induced arterial hypotension. Anesthesiology. 2003;98:1112–1118.

116. Greer D, Scripko P, Bartscher J, Sims J, Camargo E, Singhal A, Parides M, Furie K. Clinical MRI interpretation for outcome predic- tion in cardiac arrest. Neurocrit Care. 2012;17:240–244. doi: 10.1007/ s12028-012-9716-y.

117. Orioles A, Morrison WE, Rossano JW, Shore PM, Hasz RD, Martiner AC, Berg RA, Nadkarni VM. An under-recognized benefit of cardiopulmonary resuscitation: organ transplantation. Crit Care Med. 2013;41:2794–2799. doi: 10.1097/CCM.0b013e31829a7202.

118.

Matsumoto CS, Kaufman SS, Girlanda R, Little CM, Rekhtman Y, Raofi V, Laurin JM, Shetty K, Fennelly EM, Johnson LB, Fishbein TM. Utilization of donors who have suffered cardiopulmonary arrest and resuscitation in intestinal transplantation. Transplantation. 2008;86:941–946. doi: 10.1097/TP.0b013e3181852f9a.

119. Asher J, Navarro A, Watson J, Wilson C, Robson L, Gupta A, Gok M, Balupuri S, Shenton B, Del Rio Martin J, Sen B, Jaques B, Soomro N, Rix D, Manas D, Talbot D. Does donor cardiopulmonary resuscita- tion time affect outcome in uncontrolled non-heart-beating donor renal transplants? Transplant Proc. 2005;37:3264–3265. doi: 10.1016/j. transproceed.2005.09.006.

120. Reynolds JC, Rittenberger JC, Callaway CW; Post Cardiac Arrest Service. Patterns of organ donation among resuscitated patients at a regional cardiac arrest center. Resuscitation. 2014;85:248–252. doi: 10.1016/j. resuscitation.2013.11.001.

121. Adrie C, Haouache H, Saleh M, Memain N, Laurent I, Thuong M, Darques L, Guerrini P, Monchi M. An underrecognized source of organ donors: patients with brain death after successfully resuscitated cardiac arrest. Intensive Care Med. 2008;34:132–137.

122. Ali AA, Lim E, Thanikachalam M, Sudarshan C, White P, Parameshwar J, Dhital K, Large SR. Cardiac arrest in the organ donor does not negatively influence recipient survival after heart transplantation. Eur J Cardiothorac Surg. 2007;31:929–933.

123. Matsumoto CS, Kaufman SS, Girlanda R, Little CM, Rekhtman Y, Raofi V, Laurin JM, Shetty K, Fennelly EM, Johnson LB, Fishbein TM. Utilization of donors who have suffered cardiopulmonary arrest and resuscitation in intestinal transplantation. Transplantation. 2008;86:941–946.

124. Mercatello A, Roy P, Ng-Sing K, Choux C, Baude C, Garnier JL, Colpart JJ, Finaz J, Petit P, Moskovtchenko JF, et al. Organ transplants from out-of-hospital cardiac arrest patients. Transplant Proc. 1988;20:749–750.

125. Peberdy MA, Callaway CW, Neumar RW, Geocadin RG, Zimmerman JL, Donnino M, Gabrielli A, Silvers SM, Zaritsky AL, Merchant R, Vanden Hoek TL, Kronick SL; American Heart Association. Part 9: post-cardiac arrest care: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122(suppl 3):S768–S786. doi: 10.1161/ CIRCULATIONAHA.110.971002.

126. Bernat JL. Point: are donors after circulatory death really dead, and does it matter? Yes and yes. Chest. 2010;138:13–16. doi: 10.1378/chest.10-0649.

127. Bernat JL, Capron AM, Bleck TP, Blosser S, Bratton SL, Childress JF, DeVita MA, Fulda GJ, Gries CJ, Mathur M, Nakagawa TA, Rushton CH, Shemie SD, White DB. The circulatory-respiratory determination of death in organ donation. Crit Care Med. 2010;38:963–970. doi: 10.1097/ CCM.0b013e3181c58916.

128. Committee on Hospital Care SoS, Section on Critical C. Policy state- ment?pediatric organ donation and transplantation. Pediatrics. 2010;125:822–828.

129. Gries CJ, White DB, Truog RD, Dubois J, Cosio CC, Dhanani S, Chan KM, Corris P, Dark J, Fulda G, Glazier AK, Higgins R, Love R, Mason DP, Nakagawa TA, Shapiro R, Shemie S, Tracy MF, Travaline JM, Valapour M, West L, Zaas D, Halpern SD; American Thoracic Society Health Policy Committee. An official American Thoracic Society/International Society for Heart and Lung Transplantation/Society of Critical Care Medicine/ Association of Organ and Procurement Organizations/United Network of Organ Sharing Statement: ethical and policy considerations in organ dona- tion after circulatory determination of death. Am J Respir Crit Care Med. 2013;188:103–109. doi: 10.1164/rccm.201304-0714ST.

130. Hornby K, Hornby L, Shemie SD. A systematic review of autoresus- citation after cardiac arrest. Crit Care Med. 2010;38:1246–1253. doi: 10.1097/CCM.0b013e3181d8caaa.

131. Joffe AR, Carcillo J, Anton N, deCaen A, Han YY, Bell MJ, Maffei FA, Sullivan J, Thomas J, Garcia-Guerra G. Donation after cardiocircula- tory death: a call for a moratorium pending full public disclosure and fully informed consent. Philos Ethics Humanit Med. 2011;6:17. doi: 10.1186/1747-5341-6-17.

132. Nakagawa TA, Rigby MR, Bratton S, Shemie S, Ajizian SJ, Berkowitz I, Bowens CD, Cosio CC, Curley MA, Dhanani S, Dobyns E, Easterling L, Fortenberry JD, Helfaer MA, Kolovos NS, Koogler T, Lebovitz DJ, Michelson K, Morrison W, Naim MY, Needle J, Nelson B, Rotta AT, Rowin ME, Serrao K, Shore PM, Smith S, Thompson AE, Vohra A, Weise K. A call for full public disclosure for donation after circulatory deter- mination of death in children. Pediatr Crit Care Med. 2011;12:375–377; author reply 377. doi: 10.1097/PCC.0b013e31820ac30c.

133. Truog RD, Miller FG. Counterpoint: are donors after circulatory death really dead, and does it matter? No and not really. Chest. 2010;138:16–18; discussion 18. doi: 10.1378/chest.10-0657.