Basic Life Support

Dangers?

Responsive?

Send for help

Open Airway

Normal Breathing?

Start CPR
30 compressions : 2 breaths

Attach Defibrillator (AED)
as soon as available, follow prompts

Continue CPR until responsiveness or normal breathing return

January 2016
Advanced Life Support for Adults

**Start CPR**
- 30 compressions : 2 breaths
- Minimise Interruptions

**Attach**
- Defibrillator / Monitor

**Assess Rhythm**

**Shockable**
- **Shock**
  - CPR for 2 minutes

**Non Shockable**
- **Return of Spontaneous Circulation?**
  - **CPR** for 2 minutes

**During CPR**
- Airway adjuncts (LMA / ETT)
- Oxygen
- Waveform capnography
- IV / IO access
- Plan actions before interrupting compressions
  - (e.g. charge manual defibrillator)

**Drugs**
- **Shockable**
  - * Adrenaline 1 mg after 2nd shock (then every 2nd loop)
  - * Amiodarone 300mg after 3 shocks
- **Non Shockable**
  - * Adrenaline 1 mg immediately (then every 2nd loop)

**Consider and Correct**
- Hypoxia
- Hypovolaemia
- Hyper / hypokalaemia / metabolic disorders
- Hypothermia / hyperthermia
- Tension pneumothorax
- Tamponade
- Toxins
- Thrombosis (pulmonary / coronary)

**Post Resuscitation Care**
- Re-evaluate ABCDE
- 12 lead ECG
- Treat precipitating causes
- Aim for: SpO2 94-98%, normocapnia and normoglycaemia
- Targeted temperature management

January 2016

NEW ZEALAND Resuscitation Council
WHAKAHAIORA AOTAROA
ANZCOR Guideline 11.2 – Protocols for Adult Advanced Life Support

Summary

Who does this guideline apply to?
This guideline applies to adults who require advanced life support (ALS).

Who is the audience for this guideline?
This guideline is for health professionals and those who provide healthcare in environments where equipment and drugs are available.

Recommendations
The Australian and New Zealand Committee on Resuscitation (ANZCOR) make the following recommendations:

1. That the Adult ALS algorithm be used as a tool to manage all adults who require advanced life support.
2. Good quality CPR and reducing time to defibrillation are the highest priorities in resuscitation from sudden cardiac arrest.
3. Rescuers should aim to minimise interruptions to CPR during any ALS intervention.
1 Advanced Life Support Algorithm

The flow diagram illustrates the sequence of actions to be undertaken once equipment and drugs are available. Several tasks in the diagram may be undertaken at the same time.

The algorithm is based on the following considerations:

1. The importance of good CPR and early defibrillation in achieving successful outcomes. Ventricular Fibrillation (VF) is in many situations the primary rhythm in sudden cardiac arrest. The vast majority of survivors come from this group.

   The chance of successful defibrillation decreases with time. Therefore the performance of good CPR and decreasing the time to defibrillation are the highest priorities in resuscitation from sudden cardiac arrest.

   The amplitude and waveform of VF deteriorate as high energy phosphate stores in the myocardium decrease. This rate of decrease can be slowed, or even reversed by effective BLS.\(^1\)

2. Automated External Defibrillators (AEDs) can accurately diagnose cardiac rhythms and separate them into two groups:
   a. “Shockable” – those responsive to defibrillation
   b. “Non-shockable” = those unresponsive to defibrillation

3. There are interventions that are indicated in all causes of cardiac arrest.

4. There is a group of potentially reversible conditions that, if unrecognised or left untreated during cardiac arrest, may prevent successful resuscitation.

2 Notes on the Algorithm

2.1 Good quality CPR

The provision of good quality CPR is the cornerstone of advanced life support. As outlined in Guideline 11.1.1 this includes delivery of chest compressions over the lower half of the sternum at a depth of at least 5 cm, and at a rate of approximately 100-120 per minute, while minimising interruptions to compressions at all times.

2.2 Assess rhythm

As soon as the defibrillator is available, the pads should be placed on the patient’s chest, it should be charged and, the rhythm analyzed. If a rhythm compatible with spontaneous circulation is observed, the defibrillator should be disarmed and the pulse checked [Class A; Expert Consensus Opinion].
2.3 Shockable Rhythm

- Ventricular fibrillation is asynchronous chaotic ventricular activity that produces no cardiac output.
- Pulseless ventricular tachycardia is a wide complex regular tachycardia associated with no clinically detectable cardiac output.
- A defibrillator shock should be administered according to the algorithm.
- Administer a single shock and immediately resume CPR for 2 minutes after delivery of shock. Do not delay recommencing CPR to assess the rhythm. [Class A; LOE II to IV].

2.4 Energy levels

- **Monophasic**: the energy level for adults should be set at maximum (usually 360 Joules) for all shocks. [Class A; LOE II].

- **Biphasic waveforms**: the default initial energy level for adults should be set at 200J. Other energy levels may be used providing there is relevant clinical data for a specific defibrillator that suggests that an alternative energy level provides adequate shock success (eg. usually greater than 90%) [Class A; LOE III].

ANZCOR suggests that if the first shock is not successful and the defibrillator is capable of delivering shocks of higher energy, it is reasonable to increase the energy to the maximum available for subsequent shocks (CoSTR 2015 weak recommendation, very low quality evidence).³

2.5 Immediate CPR

Interruptions to CPR decrease the chance of survival from cardiac arrest. While defibrillation is of paramount importance for VF/VT, a period of well performed CPR immediately after each shock can help maintain myocardial and cerebral viability, and improves the likelihood of subsequent shock success.⁴

- During CPR advanced life support interventions are applied and potential causes of arrest sought.
- After each defibrillation continue a further 2 minutes of CPR, unless responsiveness or normal breathing become apparent.
- If using a defibrillator in manual mode, the defibrillator should be charged during CPR as the end of the 2 minute loop of CPR approaches, to minimise interruptions to CPR and increase the likelihood of shock success.⁴
- Rhythm is then reassessed and treatment is directed as necessary. If rhythm assessment results in a significant interruption to CPR then a further 2-minute period of CPR is recommended before further shocks are delivered. This is done to obtain the benefits of CPR on VF waveform and increase the likelihood of shock success.
- Consideration should be given to administration of a vasopressor in the period of CPR after the second failed defibrillation attempt. Consideration should be given to administration of an antiarrhythmic after the third failed defibrillation attempt. The sequence of escalating advanced life support would then be:
  1. attempt defibrillation ensure good CPR
  2. attempt defibrillation add vasopressor (adrenaline 1 mg)
  3. attempt defibrillation, add anti-arrhythmic (amiodarone 300 mg).
  [Class A; LOE II to IV].
2.6 Non-shockable rhythm (Non VF/VT)
- Asystole is characterised by the absence of any cardiac electrical activity.
- Pulseless Electrical Activity (PEA) (sometimes referred to Electromechanical Dissociation [EMD]) is the presence of a coordinated electrical rhythm without a detectable cardiac output.
- The prognosis in this group of cardiac rhythms or asystole is much less favourable than with VF/VT.
- During CPR advanced life support interventions are applied and potential causes of arrest sought.
- Defibrillation is not indicated and the emphasis is on CPR and other ALS interventions (e.g., intravenous access, consideration of advanced airway, drugs and pacing).

[Class A; Expert consensus opinion].

2.7 During CPR

The following interventions apply to all rhythms and are carried out continuously or during each loop of the algorithm. Each loop comprises 5 sets of 30 compressions (at approximately 100-120 per minute) : 2 breaths, which equates to approximately 2 minutes.

Other management priorities during CPR:
- Minimise interruptions to CPR during ALS interventions [Class A; LOE III-2].
- Administer 100% oxygen when available (CoSTR 2015 weak recommendation, very low quality evidence).³
- Obtain intravenous or intra-osseous access [Class A; LOE II].
- Consider airway adjuncts, but attempts to secure the airway should not interrupt CPR for more than 5 seconds [Class A; Expert consensus opinion].
- Waveform capnography should be used to confirm airway placement and monitor the adequacy of CPR (CoSTR 2015 strong recommendation, low quality evidence).³
- Adrenaline should be administered every second loop (approximately every 4 minutes) [Class A; Expert consensus opinion].
- Other drugs/electrolytes should be considered depending on the individual circumstances [Class A; Expert consensus opinion].

2.8 Medications during CPR

Vasopressors
There are no placebo-controlled studies that show that the routine use of any vasopressor at any stage during human cardiac arrest increases survival to hospital discharge, though they have been demonstrated to increase Return of Spontaneous Circulation. Current evidence is insufficient to support or refute the routine use of any particular drug or sequence of drugs. Despite the lack of human data it is reasonable to continue to use vasopressors on a routine basis.¹

Adrenaline (1 mg), when indicated, should be administered after rhythm analysis (+ shock), at the time of recommencement of CPR [Class A; Expert consensus opinion].

Antiarrhythmics
There is no evidence that giving any antiarrhythmic drug routinely during human cardiac arrest increases rate of survival to hospital discharge. In comparison with placebo and lignocaine the use of amiodarone in shock-refractory VF improves the short-term outcome of survival to hospital admission. Despite the lack of human long-term outcome data it is reasonable to continue to use antiarrhythmic drugs on a routine basis.⁵
Amiodarone (300 mg) should be administered after the third failed attempt at defibrillation, at the time of recommencement of CPR [Class A; LOE II].

Other drugs
There is no evidence that routinely giving other drugs (e.g. buffers, aminophylline, atropine, calcium, magnesium) during human cardiac arrest increases survival to hospital discharge.5

2.9 Correct Reversible Causes

Very few data address the aetiology of cardiac arrest directly. One prospective study and one retrospective study suggested that rescuers can identify some non-cardiac causes of some arrests.6,7 The physical circumstances, history, precipitating events, clinical examination, or the use of adjunct techniques (such as ultrasound) may enable the rescuer to determine a cardiac or non-cardiac cause of the cardiorespiratory arrest. The rescuer should undertake interventions based on the presumed aetiology (cardiac or non-cardiac).

4 Hs and 4 Ts are a simple reminder of conditions that may precipitate cardiac arrest or decrease the chances of successful resuscitation. These conditions should be sought and, if present, corrected in every case [Class A; Expert consensus opinion].

- Hypoxaemia
- Hypovolaemia
- Hyper/hypokalaemia & metabolic disorders
- Hypo/hyperthermia
- Tension pneumothorax
- Tamponade
- Toxins / poisons / drugs
- Thrombosis-pulmonary / coronary

Fluid administration
There is insufficient evidence to recommend for or against the routine infusion of intravenous fluids during cardiac arrest resuscitation.5
Fluids should be infused if hypovolemia is suspected (hypovolaemic shock would normally require the administration of at least 20 mL/kg) [Class A; Expert consensus opinion].

Thrombolytics
Routine administration of fibrinolytics for the treatment of in-hospital and out-of hospital cardiac arrest is not recommended.5
Fibrinolysis should be considered in adult patients with cardiac arrest with proven or suspected pulmonary embolism [Class A; Expert consensus opinion].

2.10 Post Resuscitation Care

After the return of spontaneous circulation (ROSC), post-resuscitation care commences (see Guideline 11.7 and 11.8).
Re-evaluate the patient using the standard ABCDE approach: Airway Breathing Circulation Disability and Exposure.

Other considerations include obtaining a 12 lead ECG and a chest radiograph. The adequacy of perfusion should be assessed, and the need for reperfusion therapy should be considered (eg, thrombolytics or percutaneous coronary intervention). The adequacy of oxygenation and ventilation should be confirmed and maintained (and advanced airway may be required).

Targeted Temperature Management may be instituted if indicated, and further investigation for reversible causes should be continued, and treatment instituted where necessary. See also guideline 11.7 and 11.8 [Class A; Expert consensus opinion].

References


Advanced Life Support for Adults

Start CPR
30 compressions : 2 breaths
Minimise interruptions

Attach
Defibrillator / Monitor

Assess Rhythm

Shockable
Shock
CPR
for 2 minutes

Non Shockable

Return of Spontaneous Circulation?
CPR
for 2 minutes

Post Resuscitation Care

During CPR
Airway adjuncts (LMA / ETT)
Oxygen
Waveform capnography
IV / IO access
Plan actions before interrupting compressions
(e.g. change manual defibrillator)

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* Adrenaline 1 mg after 2nd shock (then every 2nd loop)
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Hypoxia
Hypovolaemia
Hyper / hypokalaemia / metabolic disorders
Hypothermia / hyperthermia
Tension pneumothorax
Tarrpouche
Toxins
Thrombosis (pulmonary / coronary)

Post Resuscitation Care
Re-evaluate ABCDE
12 lead ECG
Treat precipitating causes
Aim for: SpO2 94-99%, normocapnia and normoglycaemia
Targeted temperature management
Chapter 6

Cardiac Resuscitation

Dana P. Edelson

6.1 EPIDEMIOLOGY

There are an estimated 200,000 cardiac resuscitation attempts in US hospitals each year, of which one-third occur on general inpatient wards. Unlike the out-of-hospital setting, cardiac arrest in the hospital is often the progression of the patient's underlying acute disease process. As such, hypotension and/or acute respiratory insufficiency are frequent immediate causes and the presenting pulseless rhythm is shockable (e.g. ventricular fibrillation or tachycardia (VF/VT)) in fewer than one quarter of cases. The distinction between shockable and non-shockable rhythms is important not only for treatment but also for prognosis since ~33% of those patients with an initial cardiac rhythm of VF/VT survive to hospital discharge, compared with ~10% for pulseless electrical activity (PEA) or asystole. Interestingly, of the patients who survive to discharge, over 70% have good neurologic outcomes. This chapter reviews cardiac resuscitation from the perspective of the hospitalist who is often a critical member of the resuscitation team.

6.2 PHASES OF IN-HOSPITAL RESUSCITATION

Resuscitations in the hospital can be divided into three phases, with different goals and priorities (Table 6.1).
Table 6.1  In-hospital Resuscitation Phases.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Goal</th>
<th>Priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Life Support (BLS) First 3 minutes</td>
<td>Start CPR immediately, Defibrillate within 3 minutes</td>
<td>Identify of cardiac arrest, Call for help/defibrillator, Begin CPR/bag mask ventilation, Analyze rhythm (distinguish shockable from non-shockable)</td>
</tr>
<tr>
<td>Advanced Cardiac Life Support (ACLS) Ongoing resuscitation</td>
<td>Maintain adequate perfusion until spontaneous circulation is restored</td>
<td>Secure access, Secure airway, Monitor CPR quality, Administer drugs, Identify and treat reversible causes</td>
</tr>
<tr>
<td>Post-Resuscitation Care – Return of Spontaneous Circulation (ROSC)</td>
<td>Prevent recurring cardiac arrest, Maximize neurologic outcome</td>
<td>Optimize oxygenation and ventilation, Treat hypotension, Consider therapeutic hypothermia, Consider coronary reperfusion, Treat hyperglycemia, Assess prognosis</td>
</tr>
</tbody>
</table>

6.2.1  Basic Life Support (BLS) Phase

The first few minutes of a resuscitation are arguably the most important and yet the most chaotic, as providers arrive and the resuscitation team composes itself. Survival from cardiac arrest is correlated with time to CPR and in the case of VF/VT with time to first shock (Figure 6.1). During the BLS phase, the goal is to initiate chest compressions within 10 seconds and deliver a shock, if indicated, within 3 minutes. Thus, interventions that can delay defibrillation should be deferred until after this first attempt and remaining steps run in tandem, if multiple rescuers are present. (Figure 6.2)

**TAKE HOME POINT #1**

Cardiac arrests with shockable rhythms of ventricular fibrillation and pulseless ventricular tachycardia require defibrillation within 3 minutes.

Recognition and activation of emergency response. Cardiac arrest should be suspected in any unresponsive patient who is not breathing normally (e.g. gasping or apneic). This should prompt an immediate activation of the hospital’s emergency plan and summon a defibrillator to the bedside, with additional rescuers. Cardiac arrest should be confirmed by carotid palpation for 5–10 seconds.
Initiation of CPR. If no pulse is appreciated within 10 seconds, one resucer should begin CPR by compressing the lower half of the patient’s sternum at a rate of at least 100/min and a depth of at least 2 inches, allowing full chest recoil between compressions. A second rescuer should prepare for ventilation. If the patient does not have an advanced airway in place at the time of cardiac arrest, chest compressions should be paused briefly after every 30 compressions to deliver 2 breaths with a bag-valve-mask, allowing 1 second per breath. In patients with advanced airways, asynchronous ventilation should be provided at a rate of 8–10/min without pausing chest compressions.

Defibrillation. Meanwhile, the arriving defibrillator should be attached and turned on, continuing chest compressions until the monitor is able to pick up a rhythm. The rhythm should be analyzed quickly for the presence of a shockable rhythm. If VF or VT is present, a shock should be administered within 10 seconds of pausing chest compressions, using the manufacturer’s recommended energy level (or 200 Joules if unknown). If using a monophasic defibrillator, 360 Joules is administered. If a rescuer able to operate a manual defibrillator, is not readily available, an automated external defibrillator (AED) or AED-mode on a manual defibrillator should be used. However, AEDs can result in prolonged pauses in chest compression and may be associated with worse outcomes for those patients with PEA or asystole when compared to manual defibrillators. Chest compressions should be resumed immediately after defibrillation without rechecking the rhythm or pulse.

6.2.2 Advanced Cardiac Life Support (ACLS) Phase

Following the first rhythm check, the resuscitation moves into the ACLS phase (Figure 6.3) with a goal of maintaining adequate perfusion and restoring a pulse. In this phase, the quality of CPR is paramount as is identifying and treating reversible causes.
Figure 6.2  BLS healthcare provider algorithm. (Source: Berg RA et al. 2010. Reproduced with permission of Wolters Kluwer Health).

**Ensuring high CPR quality.** The key aspects of CPR quality are listed in Table 6.2. These include ensuring a depth of >2 inches, rate of at least 100/min, allowing full recoil, minimizing pauses in chest compression and avoiding hyperventilation. Interventions previously deferred in the BLS phase, such as advanced airway placement and intravenous or intraosseous (IV/IO) line placement, should be attempted during ongoing chest compressions. If a pause in compressions is required it should be timed with the next scheduled pause for rhythm check, compressor rotation, and possible defibrillation.
**Figure 6.3** ACLS Cardiac Arrest Circular Algorithm. (Source: Neumar RW et al. 2010. Reproduced with permission of Wolters Kluwer Health.)
**Table 6.2 CPR Quality Components and Strategies for Improvement.**

<table>
<thead>
<tr>
<th>Components</th>
<th>Strategies for achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression depth &gt;2</td>
<td>Rotate compressors every 2 minutes to avoid fatigue</td>
</tr>
<tr>
<td>Full recoil between compressions</td>
<td>Adjust the height of the bed and/or position of the rescuer to balance the upper body strength required with the need to lean on the patient</td>
</tr>
<tr>
<td>Compression rate &gt;100/min</td>
<td>Consider incorporation of real-time CPR feedback such as a CPR sensing and feedback device, continuous capnography or arterial waveform tracing</td>
</tr>
<tr>
<td>Minimize interruptions</td>
<td>Consider use of a metronome or song with a beat of 100/min</td>
</tr>
<tr>
<td>Avoid excessive ventilation</td>
<td>Coordinate pauses for interventions with rhythm/pulse checks and compressor rotation</td>
</tr>
<tr>
<td></td>
<td>Count 5–6 seconds between breaths</td>
</tr>
<tr>
<td></td>
<td>Consider using a pediatric bag-valve</td>
</tr>
</tbody>
</table>

**TAKE HOME POINT #2**

High-quality CPR is critical to cardiac resuscitation and requires adequate rate and depth of chest compressions without leaning, minimization of pauses, and avoidance of hyperventilation.

**Drug therapy.** Pharmacologic adjuncts should be administered during this phase as well (Table 6.3). While there are no data to show an improvement in survival with the use of any cardiac arrest medications, the use of epinephrine 1 mg IV/IO every 3–5 minutes has been shown to increase the likelihood of achieving a pulse. Vasopressin likely works similarly and may even have benefit in conjunction with epinephrine for prolonged resuscitations. Therefore, rescuers may opt to exchange either the first or second epinephrine dose for vasopressin. Refractory VF/VT should be treated with an antiarrhythmic agent after the third defibrillation attempt, of which amiodarone is preferred. Atropine is no longer recommended for cardiac arrest.

**Treatment of reversible causes.** The presence of pulseless electrical activity as the arrest rhythm should prompt a search for reversible primary etiologies (Table 6.4). This evaluation should include a review of the patient’s immediate history for clues, auscultation of breath sounds bilaterally, examination of neck veins, a point of care glucose level and possibly an arterial blood gas, with point of care chemistries and hemoglobin, if available. Routine laboratory studies, even if run on a STAT basis, are unlikely to change management acutely due to delays and will need to be redrawn if the patient is successfully resuscitated. Portable chest X-rays and 12-lead ECGs should not be obtained on a pulseless patient as they require prolonged pauses in
### Table 6.3 Adjuvant Drug Therapy During CPR.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Indication</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine</td>
<td>Vasopressor used to increase likelihood of successful resuscitation</td>
<td>IV/IO dose: 1 mg (10 mL of 1:10,000 solution), followed by 20 mL flush Q 3–5 minutes during resuscitation. Endotracheal route: 2–2.5 mg diluted in 10 mL NS.</td>
</tr>
<tr>
<td>Vasopressin</td>
<td>Alternative/adjunct to epinephrine</td>
<td>One dose of 40 units IV/IO push may replace either first or second dose of epinephrine.</td>
</tr>
<tr>
<td>Amiodarone</td>
<td>Antiarrhythmic used for refractory VF/VT</td>
<td>First dose: 300 mg IV/IO push. Second dose (if needed): 150 mg IV/IO push.</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>Alternative to amiodarone</td>
<td>Initial dose: 1 to 1.5 mg/kg IV/IO. For refractory VF may give additional 0.5 to 0.75 mg/kg IV push, repeat in 5–10 minutes, maximum 3 doses or total of 3 mg/kg.</td>
</tr>
<tr>
<td>Magnesium sulfate</td>
<td>Reversal of cardiac arrest due to hypomagnesemia or Torsade de Pointes</td>
<td>1–2 g (2 to 4 mL of a 50% solution) diluted in 10 mL of D₅W IV/IO.</td>
</tr>
</tbody>
</table>

### Table 6.4 Common Causes of PEA (Hs and Ts).

<table>
<thead>
<tr>
<th>Condition</th>
<th>Possible interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypovolemia</td>
<td>IV fluid</td>
</tr>
<tr>
<td>Hypoxia</td>
<td>Advanced airway</td>
</tr>
<tr>
<td>Hydrogen ions (acidosis)</td>
<td>Supplemental oxygen</td>
</tr>
<tr>
<td>Hyper-/Hypokalemia</td>
<td>NaHCO₃</td>
</tr>
<tr>
<td></td>
<td>CaCl</td>
</tr>
<tr>
<td></td>
<td>NaHCO₃</td>
</tr>
<tr>
<td></td>
<td>Insulin with glucose</td>
</tr>
<tr>
<td></td>
<td>Albuterol</td>
</tr>
<tr>
<td></td>
<td>Magnesium</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>Rewarming</td>
</tr>
<tr>
<td>Tension pneumothorax</td>
<td>Needle thoracotomy or chest tube</td>
</tr>
<tr>
<td>Tamponade (cardiac)</td>
<td>Pericardiocentesis</td>
</tr>
<tr>
<td>Toxins</td>
<td>Specific antidotes</td>
</tr>
<tr>
<td></td>
<td>Hemodialysis</td>
</tr>
<tr>
<td>Thrombosis (pulmonary embolus)</td>
<td>Surgical embolectomy</td>
</tr>
<tr>
<td>Thrombosis (acute MI)</td>
<td>Fibrinolytics</td>
</tr>
<tr>
<td></td>
<td>Percutaneous intervention (PCI)</td>
</tr>
</tbody>
</table>
compressions. Persistent VF/VT should prompt consideration of acute myocardial ischemia or infarction.

**TAKE HOME POINT #3**

Always assess for and treat reversible causes of cardiac arrest.

**Termination of resuscitation efforts.** Sustained spontaneous circulation is achieved in an average of ~50% of in-hospital cardiac arrest patients. Recognition of futility and termination of efforts are therefore an important aspect of resuscitation. While there have been attempts to develop and test resuscitation termination rules in the out-of-hospital setting, there are few data to guide rescuers performing resuscitation in the hospital. However, for hospitals using continuous capnography, one fairly sensitive and specific predictor of death is an end-tidal carbon dioxide ETCO2 <10 mmHg at 20 minutes into the resuscitation.

**6.2.3 Post-Resuscitation Care Phase**

For those that survive the initial resuscitation attempt, defined as the presence of a spontaneous pulse for >20 minutes, the focus should turn to maintaining hemodynamic stability and increasing the likelihood of survival to discharge with good neurologic function. This generally requires transfer to an intensive care unit and following of the post-resuscitation protocol (Figure 6.4).

**Optimize oxygenation, ventilation and hemodynamics.** Inspired oxygen should be weaned to the lowest percent that will maintain an oxyhemoglobin concentration of ≥ 94% and hyperventilation should be avoided. Respiratory rates should be titrated to achieve an ETCO2 of 35-40 mmHg or PaCO2 of 40-45 mmHg. An IV fluid bolus of 1-2L is often helpful in the early post-resuscitation phase to treat hypotension. This should be chilled saline (4°C) if initiating hypothermia. In addition, a vasopressor infusion is often required and should be prepared immediately upon ROSC in anticipation of a drop in blood pressure. Epinephrine (0.1-0.5 mcg/kg), dopamine (5-10 mcg/kg), or norepinephrine (0.1-0.5 mcg/kg) titrated to maintain a mean arterial pressure >65 are good initial choices.

**Therapeutic hypothermia.** Patients who are comatose following cardiac arrest should be considered for induction of hypothermia. While the majority of the benefit has been shown in the out-of-hospital setting for patients with VF arrests, there are some data to support its use following cardiac arrest in the hospital regardless of presenting rhythm. The optimal method to achieve hypothermia is not known but cold saline, surface cooling techniques and endovascular devices have all been described. The goal is to achieve a temperature of 32-34°C for 12-24 hours. Maintenance within that range may require thermostatic feedback to prevent under- and overshoots of target temperature.
Figure 6.4  Post-cardiac arrest care algorithm. (Source: Peberdy MA, Neumar RW et al. 2010. Reproduced with permission of Wolters Kluwer Health).
Chapter 6  Cardiac Resuscitation

**TAKE HOME POINT #4**

If available, therapeutic hypothermia should be considered for comatose survivors of cardiac arrest, although data in the inpatient setting are limited.

**Coronary reperfusion.** A 12-lead ECG should be obtained in the early ROSC period and reviewed for signs of acute myocardial ischemia. If suspected, early coronary angiography followed by appropriate revascularization of culprit lesions should be considered.

**Prognostication.** There are no reliable predictors of long-term outcomes in the first 24 hours following ROSC. The absence of pupillary light and corneal reflexes after 72 hours is fairly specific for poor outcome in patients who have not received hypothermia. In addition, unprocessed EEG findings and somatosensory evoked potentials may also be useful after 24 hours. As a result, withdrawal of care within 24, and possibly even 72, hours following ROSC is likely premature. Engaging families and other decision-makers early on in these discussions is important.

**TAKE HOME POINT #5**

Neurologic prognostication should not be attempted before 24 hours following ROSC and may require waiting at least 72 hours.

**KEY REFERENCES**


Potentially reversible causes of cardiac arrest

**Hypoxia**

This is a common cause of cardiac arrhythmias and subsequent cardiac arrest. Always assume its presence, even with evidence of normal arterial blood gas results. The best treatment is effective airway management with ventilatory support and high percentages of supplementary oxygen. The ALS algorithm highlights the use of buffers (for example, sodium bicarbonate); however, their role is still uncertain and only advocated when blood pH is < 7.1 (RCUK 2005).

**Hypovolaemia**

Blood/fluid loss leads to under-perfusion of vital organs with resultant hypoxia and loss of haemodynamic stability. A high index of suspicion for hypovolaemia should be given to any patient presenting with a recent history of surgery, haemorrhage, trauma, dehydration, sepsis or heat-related illnesses. Treatment is to replace volume with either a crystalloid (such as 1L of 0.9% saline) or colloid (such as Haemaccel® or Gelofusine®) solution to restore adequate cardiac refilling and output. Ideally blood products should be administered if active bleeding is thought to be the cause of the arrest.

**Hyper/hypokalaemia/metabolic**

Cardiac arrest due to electrolyte abnormalities is uncommon except in the case of hypo- or hyperkalaemia. Renal failure is a common cause of hyperkalaemia, while dehydration and long-term use of diuretics may cause hypokalaemia. Obtain blood samples for electrolyte analysis and assess previous electrolyte results. Correcting any imbalance is based upon the severity of the problem. A blood gas analysis can also provide a fast potassium result if necessary. Ensure that a bedside blood glucose analysis is performed to exclude hypo- or hyperglycaemia.

**Hypothermia**

Hypothermia inhibits the movement of electrolytes across cell membranes and, therefore, affects the polarity of myocardial cells. Patients rarely present with hypothermia as a primary condition. However, there is a risk that patients who have returned from prolonged surgical procedures, are intoxicated, elderly or present in a collapsed state could be hypothermic (core temperature < 35°C). The hypothermic heart may have a reduced response to pacemaker stimulation, defibrillation and cardioactive drugs. The latter may accumulate to toxic levels. Consequently, modification and prolongation of the ALS resuscitation may be required until the core temperature rises above 35°C. Active rewarming with heaters and warmed intravenous fluids are the treatments of choice in ward areas. Other specialist critical care areas may attempt more invasive treatments.
**Tension pneumothorax**

This is a rare cause of PEA and is usually diagnosed with a high index of suspicion due to the patient’s presenting problem before cardiac arrest. Once the patient’s airway has been secured with an endotracheal tube, diagnosis may become easier as there will be increased resistance to ventilation and absence of air entry either unilaterally or bilaterally as the tension (pressure) within the thoracic cavity increases. Tension pneumothorax should always be considered in the young asthmatic patient who is in PEA. Immediate treatment is with needle decompression (i.e. placing a large-bore needle or cannula in the second intercostal space, mid-clavicular line on the affected side or bilaterally if indicated). This should be followed by the insertion of a chest drain if the resuscitation is successful.

**Toxins**

Toxic substances are the second most common cause of cardiac arrest in 18- to 35-year-olds (International Liaison Committee on Resuscitation 1997). In a ward environment, always check the medication chart to ascertain what may have been administered to the patient that could have precipitated the PEA arrest. The basic principles of restoring circulation and oxygenation apply here along with the identification of the toxic substance (e.g. opiate drugs, illegal substances) and the prevention of further absorption. The antidote to opiate medications, naloxone, may be given intramuscularly and intravenously if overdose is suspected. As the half-life of naloxone is relatively short, an intramuscular dose is given to ensure that therapeutic levels are maintained when the intravenous dose loses its effectiveness. Consult your local poisons unit for advice regarding antidotes for other drugs.

**Thromboembolic**

Usually caused by a large coronary or pulmonary embolus or cerebrovascular accident. Treatment is limited and the prognosis is poor. The use of anticoagulants or thrombolytic agents in this situation requires further research and may be administered in certain circumstances after consultation with expert clinicians.

**Tamponade**

Cardiac tamponade can occur with as little as 10 mL of fluid occupying the pericardial space. This leads to malfunctioning of the heart’s pump action. The most common cause of acute tamponade in a ward environment is rupture of the ventricular free wall following acute myocardial infarction (Nolan et al. 1999). Cardiac tamponade is usually diagnosed by Beck’s triad of symptoms. In usual circumstances, the three symptoms of muffled heart sounds, distended neck veins and hypotension are indicative of cardiac tamponade, but in the cardiac arrest situation they are not present.
As tamponade is so difficult to diagnose and treat, it is usually considered last in the potentially reversible causes of cardiac arrest. The exception to this is when chest trauma or cardiothoracic surgery is involved. Successful resuscitation in these circumstances usually requires a sternotomy. Treatment with thoracocentesis (needle aspiration) requires a confident approach, skill and accuracy (usually with use of ultrasound) that is almost impossible when CPR is in progress.

Reference:

CEASE: A Guide for Clinicians on How to Stop Resuscitation Efforts
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Abstract
Resuscitation programs such as Advanced Cardiac Life Support, Cardiac Life Support, Pediatric Advanced Life Support, and the Neonatal Resuscitation Program offer inadequate guidance to physicians who must ultimately decide when to stop resuscitation efforts. These decisions involve clinical and ethical judgments and are complicated by communication challenges, group dynamics, and family considerations. This article presents a framework, summarized in a mnemonic (CEASE: Clinical Features, Effectiveness, Ask, Stop, Explain), for how to stop resuscitation efforts and communicate that decision to clinicians and ultimately the patient’s family. Rather than a decision rule, this mnemonic represents a framework based on best evidence for when physicians are considering stopping resuscitation efforts and provides guidance on how to communicate that decision.

Keywords: resuscitation; physician–patient relations; decision making

By the end of intern year, every physician-in-training knows how to initiate a resuscitation for cardiopulmonary arrest (a “code”), but few learn how to stop it. Detailed guidelines for initiating resuscitation to adults, children, and neonates are taught through the Advanced Clinical Life Support (ACLS) (1, 2), Pediatric Advanced Life Support (PALS) (2, 3) and Neonatal Resuscitation Program (4) guidelines, as well as European guidelines (5). However, deciding when resuscitation efforts should be stopped is an equally difficult decision that is mostly left to individual physicians, with almost no specific instruction from experts or adequate algorithms to assist in decision making. Since the 1970s, there have been efforts to empirically define clinical features that predict a low likelihood of survival from resuscitation and to develop clinical prediction rules for when to stop. These are not in widespread use, possibly due to factors such as the poor quality of empirical evidence (6), the risk of stopping resuscitation prematurely for some patients, and a medical culture that resists death at all costs. Additionally, the few prediction rules that exist for in-hospital cardiac arrest have not been updated for the latest versions of ACLS or PALS. For this reason, published resuscitation guidelines provide only general statements regarding when and how to stop resuscitation efforts (Tables 1 and 2).

The lack of guidelines for stopping resuscitation has left a void. Stopping a code takes place in a complex, often chaotic clinical setting. In addition, much like a decision to write a do not resuscitate order, stopping resuscitation is a clinical judgment based on both subjective and objective information (7). In the absence of identified uniform clinical rules for stopping resuscitation, clinicians need an easily remembered framework for how to discontinue resuscitation efforts and effectively communicate with other clinicians and family. This kind of decision entails both ethical and communication elements, all of which must be considered in the heat of the moment.

The decision to discontinue resuscitation requires considerable clinical competence and judgment. Clinicians must address key ethical and communication factors but make decisions in a time-pressured situation that is not conducive to pondering these questions in the moment (7). We believe a framework to help clinicians organize their thinking and consider several key factors would be of great use in the clinical setting. To help
American Heart Association
European Resuscitation Council
Seminar for Clinicians

Ebell and colleagues developed a prediction model for neurologic outcome and found that good neurologic function on hospital admission is most highly associated with a good neurologic outcome after resuscitation (able to work with minimal impairment), whereas trauma, stroke, and age 85 years or older are associated with greater impairment (13). In children, renal failure and epinephrine infusion before the arrest were associated with mortality (14). Therefore, knowing the patient’s history is critical. In some situations, physicians perform resuscitation on a patient they know well and are aware of these clinical factors already. Unfortunately, given the complexity of the modern hospital, many resuscitation efforts are performed by physicians who are unaware of the patient’s history. Providing the team leader with quick, accurate information about the patient’s clinical history is critical to good decision making. For purposes of acutely refining the patient’s immediate prognosis, members of the team should work together to quickly access clinical information and provide it to the code team, especially the clinician who is in charge of resuscitation efforts.

Clinical Features That Predict Survival

There is a growing body of evidence that clinical characteristics of the patient predict survival and neurologic outcomes from resuscitation. Although prediction models are imperfect at predicting outcomes for any individual patient, key clinical factors should be taken into consideration when determining the duration of resuscitation. Key prearrest factors associated with poor outcomes for adults include: pneumonia, metastatic cancer, hypotension, renal failure, and poor functional status (Table 3) (11, 12). Ebell and colleagues developed a prediction model for neurologic outcome and found that good neurologic function on hospital admission is most highly associated with a good neurologic outcome after resuscitation (able to work with minimal impairment), whereas trauma, stroke, and age 85 years or older are associated with greater impairment (13). In children, renal failure and epinephrine infusion before the arrest were associated with mortality (14). Therefore, knowing the patient’s history is critical. In some situations, physicians perform resuscitation on a patient they know well and are aware of these clinical factors already. Unfortunately, given the complexity of the modern hospital, many resuscitation efforts are performed by physicians who are unaware of the patient’s history. Providing the team leader with quick, accurate information about the patient’s clinical history is critical to good decision making. For purposes of acutely refining the patient’s immediate prognosis, members of the team should work together to quickly access clinical information and provide it to the code team, especially the clinician who is in charge of resuscitation efforts.

Effectiveness of Resuscitation Efforts

The quality of resuscitation interventions is associated with arrest outcome (15–17). Clinicians must carefully adhere to cardiopulmonary resuscitation quality metrics: adequate compression rate, adequate compression depth, full chest recoil after each compression, minimizing pauses in compressions, and avoiding excessive ventilation (Table 3) (18). It is the entire sequence of actions (flow) rather than single events that determine the success of the intervention (6).

Other clinical features of the prearrest period have also been shown to be predictive of outcomes. Initial rhythm of ventricular fibrillation or pulseless ventricular tachycardia is associated with better outcomes than asystole or pulseless electrical activity (19). One decision aid found a negative predictive value of 98.9% for being discharged alive if the patient did not have any of the following: an initial rhythm of ventricular fibrillation or ventricular tachycardia, or return of a pulse within 10 minutes of chest compressions (20). Some researchers have found that few patients survive prolonged resuscitation efforts (11), with a steep decline in survival for increased resuscitation time (21, 22). However, more recent evidence suggests that children with cardiac conditions have a higher (>20%) rate of survival with resuscitation over 35 minutes (22). Indirect evidence for longer efforts in adults comes from a large patient registry, which found that hospitals with longer resuscitation efforts are associated with arrest outcome (14). In children, renal failure and epinephrine infusion before the arrest were associated with mortality (14). Therefore, knowing the patient’s history is critical. In some situations, physicians perform resuscitation on a patient they know well and are aware of these clinical factors already. Unfortunately, given the complexity of the modern hospital, many resuscitation efforts are performed by physicians who are unfamiliar with the patient’s history. Providing the team leader with quick, accurate information about the patient’s clinical history is critical to good decision making. For purposes of acutely refining the patient’s immediate prognosis, members of the team should work together to quickly access clinical information and provide it to the code team, especially the clinician who is in charge of resuscitation efforts.

Table 1. Adult guidelines for stopping cardiopulmonary resuscitation

<table>
<thead>
<tr>
<th>Resource</th>
<th>Clinical Factors</th>
<th>Arrest-related factors</th>
<th>Decision Making</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Resuscitation Council Guidelines for Resuscitation: Ethics (25)</td>
<td>“Medical history and anticipated prognosis, the period between cardiac arrest and start of CPR, the interval to defibrillation and the period of ALS with continuing asystole and no reversible cause.”</td>
<td>Continue as long as VF persists Acceptable to stop after asystole of 20 min or more</td>
<td>Decision should be “made by the team leader, but after consultation with other team members, who may have valid points to contribute.” “…the decision is based on the clinical judgement that the patient’s arrest is unresponsive to ALS”</td>
</tr>
<tr>
<td>American Heart Association Guidelines: Ethics (38)</td>
<td>Witnessed arrest Time to CPR Initial rhythm Time to defibrillation Comorbid disease Prearrest state ROSC during resuscitative efforts</td>
<td>The evidence for clinical decision rules for adults is limited.</td>
<td>For adults: the decision to stop rests with the treating physician.</td>
</tr>
<tr>
<td>American Heart Association Advanced Cardiac Life Support Provider Manual (1)</td>
<td>Not addressed</td>
<td>Not addressed</td>
<td>Not addressed</td>
</tr>
</tbody>
</table>

Definition of abbreviations: ALS = advanced life support; CPR = cardiopulmonary resuscitation; ROSC = return of spontaneous circulation; VF = ventricular fibrillation.
times have better overall survival (23). It is hard to determine if this finding is due to the duration of resuscitation or to other factors, such as the cause of the cardiac arrest.

Given these complex and sometimes contradictory data, there is no specific clinical decision aid that is widely accepted as a guide to stop in-hospital resuscitation efforts or that has ever been included in resuscitation guidelines for in-hospital use. Clinicians are left with the difficult task of weighing key clinical factors to determine when resuscitation has such a low likelihood of success that it should be stopped. Clearly, the length of the resuscitative efforts and the patient’s physiological response in real time are key clinical factors and should be considered when evaluating whether or not to continue resuscitation efforts.

**Ask the Other Clinicians Present for Input**

ACLS guidelines now focus on the importance of good communication and teamwork among the resuscitation team. One aspect of communication is knowledge sharing (1). It is essential for the team leader to have input from other clinicians at the bedside who can contribute to decision making. Other members of the interdisciplinary team may have relevant knowledge about the patient’s clinical history or current clinical condition.

Examples may include a nurse’s concern about a recent potassium value of which the physician is unaware or a respiratory therapist’s observation that there is considerable resistance with bag valve mask ventilation. Additionally, patients or their surrogates may have revealed key information to clinicians about values and preferences that would support a focus on quality of life rather than quantity of life. Other participating clinicians may be able to suggest potentially useful interventions overlooked in the heat of the moment by the team leader.

In the hierarchical environment of the hospital, it may be hard for trainees or nonphysicians to speak up; research from both aviation (1) and medicine (24) have

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**Table 2. Pediatric**

<table>
<thead>
<tr>
<th>Resource</th>
<th>Clinical Factors</th>
<th>Arrest-related factors</th>
<th>Decision Making</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Resuscitation Guidelines for Resuscitation: Pediatrics (26)</td>
<td>Newborns: Where gestation, birth weight and/or congenital anomalies are associated with almost certain early death, and unacceptably high morbidity is likely among the rare survivors, resuscitation is not indicated.</td>
<td>Newborns: “After 10 min of continuous and adequate resuscitation efforts, discontinuation of resuscitation may be justified if there are no signs of life.”</td>
<td>Not addressed</td>
</tr>
<tr>
<td>American Heart Association Guidelines: Ethics (38)</td>
<td>Newborns: Resuscitation is not indicated for newborns with “almost certain early death and when unacceptably high mortality is likely among the rare survivors.” Children: Duration of CPR Witnessed event Number of doses of epinephrine Etiology of arrest Rhythm Age</td>
<td>In a newborn with no detectable heart rate, “it is appropriate to consider stopping resuscitation if the heart rate remains undetectable for 10 min.” There are no validated clinical rules for children.</td>
<td>For children: “In the absence of clinical decision rules, the responsible clinician should stop the resuscitative attempt if there is a high degree of certainty that the patient will not respond to further pediatric life support.”</td>
</tr>
<tr>
<td>American Heart Association Pediatric Provider Manual (3)</td>
<td>Interval from collapse to initiation of CPR; quality of CPR; duration of resuscitation; underlying conditions. Consider prolonged efforts in: Recurring or refractory VF/VT Drug toxicity Hypothermia</td>
<td>Not addressed</td>
<td>Not addressed</td>
</tr>
<tr>
<td>Neonatal Resuscitation Program Textbook (4)</td>
<td>Considerations for noninitiation of resuscitation: Confirmed gestational age &lt; 23 wk or birth weight &lt; 400 g Anencephaly Confirmed lethal genetic disorder or malformation When available data suggests an unacceptably high likelihood of death/severe disability</td>
<td>“If you can confirm that no heart rate has been detectable for at least 10 min, discontinuation of resuscitation may be appropriate.”</td>
<td>Not addressed</td>
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</tbody>
</table>

**Definition of abbreviations:** CPR = cardiopulmonary resuscitation; VF/VT = ventricular fibrillation/ventricular tachycardia.
Table 3. Potential factors in adult in-hospital resuscitation outcome

<table>
<thead>
<tr>
<th>Prearrest Clinical Factors</th>
<th>During Arrest</th>
<th>Resuscitation Efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age* (13, 48)</td>
<td>Witnessed arrest† (20)</td>
<td>Compression rate† (18)</td>
</tr>
<tr>
<td>Cancer† (11) or metastatic* (13, 48) or hematologic cancer* (13, 48)</td>
<td>Initial rhythm, ventricular fibrillation, pulseless ventricular tachycardia† (20)</td>
<td>Compression depth† (18)</td>
</tr>
<tr>
<td>Poor functional status:</td>
<td>Return of pulse within 10 min of chest compressions† (20)</td>
<td>Full chest recoil after each compression† (18)</td>
</tr>
<tr>
<td>Homebound† (11)</td>
<td>Duration of arrest (11)† (conflicting data about direction of effect)</td>
<td>Minimize interruptions in compression† (18)</td>
</tr>
<tr>
<td>Living in SNF† (13)</td>
<td></td>
<td>Avoid excessive ventilation‡ (18)</td>
</tr>
<tr>
<td>Neurologic status† (13)</td>
<td></td>
<td></td>
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<tr>
<td>Altered mental status† (48)</td>
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<td></td>
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<tr>
<td>Medical noncardiac diagnosis* (13, 48)</td>
<td></td>
<td></td>
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<tr>
<td>Pneumonia* (11, 13, 48)</td>
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<tr>
<td>Hypotension† (11, 48)</td>
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<tr>
<td>Renal insufficiency/failure* (11, 13, 48)</td>
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<tr>
<td>Acute stroke† (13)</td>
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<tr>
<td>Septicemia* (13)</td>
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<tr>
<td>Respiratory insufficiency‡ (13)</td>
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<tr>
<td>Major trauma* (13, 48)</td>
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Definition of abbreviations: ADL = activities of daily living; SNF = skilled nursing facility.
*Associated with both survival and neurological outcome.
†Associated with survival.
‡Based on expert opinion, or data from laboratory or out-of-hospital arrest studies.
§Associated with neurological outcome.

It is essential that the team leader be proactive about asking for input from other team members. It is up to the clinician running the code to make a decision about which suggestions require immediate action.

Stop Resuscitation Efforts

If resuscitation efforts are unsuccessful in achieving return of spontaneous circulation or the interventions needed to support circulation are unsustainable, it is the responsibility of the clinician running the resuscitation to decide when to stop further efforts (25, 26). Although this may seem intuitively obvious, ceasing resuscitation is an emotionally and cognitively difficult task. More than any other event, this places the physician in the position of determining the timing of the patient’s death. This may be part of the reason that many codes continue well beyond the duration that they are likely to be effective.

There are several factors that may contribute to the difficulty of stopping resuscitation efforts. First, once advance treatment interventions are started, there is tremendous momentum to continue them. This “technologic imperative” (27) may lead to continued treatment when it is no longer of benefit. Second, efforts to improve hospital quality have included general and disease-specific in-hospital mortality as quality indicators (28–30). The pressure to reduce hospital mortality may place tacit pressure on team members to continue resuscitation. Finally, these important life-or-death decisions are frequently made under pressure of time and emotion regarding patients unfamiliar to the treating clinicians.

Mounting evidence supports a change in practice from escorting family out of the room to allowing them to witness resuscitative efforts (2, 26, 31–33). Family presence has the advantage of allowing family members to witness the aggressive care provided to the patient, permits them to be present at the time of death, and may have lasting positive psychological benefits (34, 35). There are guidelines to help support families during the process and to debrief afterward (26, 33). However, there is evidence that clinicians vary in their support of family presence (36). The presence of family may make stopping the resuscitation efforts more challenging, particularly if the family has been strongly in favor of continued aggressive care.

We emphasize that it is NOT acceptable to ask the family whether or not resuscitation efforts should continue or stop (26), a strategy that several of us have witnessed in our clinical practices. Although surrogates play a key role in the decision-making process related to goals of care and treatment decisions such as code status (37), stopping resuscitation efforts is a decision that should be based on the patient’s clinical status and the likely success of ongoing resuscitation efforts (as discussed above) and therefore is not within the purview of family members. Additionally, asking a family member whether to stop resuscitation puts the burden of determining the time of death on the shoulders of the patient’s loved one. For both of these reasons, asking a family member whether resuscitation should be discontinued is ethically unacceptable.

Explain What Has Happened to the Family

When resuscitation efforts cease, the clinical team has important obligations to the family: inform them about what has
occurred, answer questions, and provide emotional support (38). In many cases, physicians will be assisted in these tasks by nurses, social workers, or chaplains. Evidence has shown that family members of critically ill adults and children are at high risk for posttraumatic stress, anxiety, and depression and that this risk is especially high if the patient dies (39, 40).

Compassionate disclosure about the events of the resuscitation, including the death of the patient if this has occurred, is an essential part of medical practice and can be taught successfully (41, 42). Core skills include showing empathy and responding to family emotions (43, 44).

The discussion will vary considerably depending on whether the patient survived and whether the family has witnessed the resuscitation. For family members who were present, the act of witnessing resuscitation may require immediate emotional support and attention from a member of the team who was not directly involved in the resuscitation efforts. For family members who were not present, clinicians need to inform them about the death in a compassionate manner, avoiding medical jargon and providing emotional support. Trainees may be helped by expert guidance for how to inform families about bad news, such as the SPIKES (setting up the interview, patient’s perception, invitation, knowledge, emotions) protocol (45), and may benefit from training that includes role play and other active learning strategies (46, 47).

**Discussion**

In the absence of a do not resuscitate order, the decision to start resuscitation is automatic and rests frequently with nurses, who are the providers most likely to be present when a patient has a cardiopulmonary arrest. However, the decision to continue or terminate resuscitative efforts rests with the clinician leading resuscitation efforts, usually a physician. The lack of clinical prediction rules means that clinicians involved in the code must use the available information about the patient’s premorbid condition, current acute illness, and the trajectory of the resuscitation to determine when to discontinue efforts. This lack of clear guidelines requires that clinicians make the judgment to stop resuscitation efforts in a situation of uncertainty.

We propose the CEASE framework as a helpful framework for physicians and other clinicians who are learning resuscitation skills. Instead of providing a decision rule for stopping resuscitation based on clinical factors, we have outlined a process for considering when to discontinue resuscitative efforts and how to effectively communicate with clinicians and family. It is meant to complement existing ACLS, PALS, CLS, and Neonatal Resuscitation Program guidelines to provide care that is clinically sound; is respectful of the patient, family, and the clinical team; and flows from ethically sound principles. We emphasize that the clinician directing the resuscitation must decide when to stop efforts and cannot look to family members to make this decision. Finally, our obligation to family involves providing information and support during their time of loss.

**Author disclosures** are available with the text of this article at www.atsjournals.org.


Crisis Resource Management (CRM)

Reviewed and revised 23 February 2014

OVERVIEW

- CRM refers to the non-technical skills required for effective teamwork in a crisis situation
- Numerous factors affect the performance of complex tasks at the level of the individual, team and the environment
- CRM originated with Crew (or ‘Cockpit’) Resource Management training developed by the aviation industry in the 1970s following the realisation that 70% of airline crashes were due to human error resulting from teamwork failure
- CRM training improves performance and reduces errors (settings include ED, trauma teams and MET teams)

FACTORS AFFECTING THE PERFORMANCE OF COMPLEX TASKS

Individual (e.g. HALTS – hungry, angry, late, tired or stressed)

- Fatigue
- Sleep deprivation
- Emotional disturbance (e.g. angry, stressed)
- Ill health
- Inexperience
- Lack of knowledge

Team

- Role confusion
- High power distance/ authority gradient
- Ineffective communication techniques

Environment

- Interruptions
- Noise
- Handovers
- Production pressure
- Equipment failure
- Unfamiliar place and equipment
KEY PRINCIPLES OF CRM

The way key principles are organised in this document is as follows:

- Know your environment
- Anticipate, share and review the plan
- Ensure leadership, role clarity and good teamwork
- Communicate effectively
- Call for help early
- Allocate attention wisely – avoid fixation
- Distribute the workload – monitor and support team members

KNOW YOUR ENVIRONMENT

- Know location and function of equipment, especially for time-critical procedures
- Logically structured and well labelled environment
- Use cognitive aids e.g. equipment maps
- Regular training
- Know the role and level of experience of team members (role confusion is common in the ED resus room setting)

ANTICIPATE, SHARE AND REVIEW THE PLAN

- Think ahead and plan for all contingencies
- Set priorities dynamically
- Re-evaluate periodically
- Anticipate delays
- Use checklists
- Share the plan with others – sharing the mental model facilitates effective action towards a common goal
- Think out loud and provide periodic briefings to verbalise priorities, goals and clinical findings as they change
- Encourage team members to share relevant thoughts and plans
- Continually review the plan based on observations and response to treatment

ENSURE LEADERSHIP, ROLE CLARITY AND GOOD TEAMWORK

- Employ the least confrontational approach consistent with the goal
- Participative decision making improves team buy in
- Use an authoritative approach when necessary (e.g. time critical situations)
- Allocate team roles
- Establish behavioural and performance expectations of team members
- Establish and maintain the team’s shared mental model of what is happening and the team’s goals
- Monitor the external and internal environments of the team to avoid being caught off guard
- Team members should show good followership and be active – each observes and monitors events and advocates or asserts corrective actions
- Leader provides debriefing
- Team members including the Leader need to be able to recognise when they are affected by stress, and develop appropriate self-care behaviours
- All team members – Leaders and Followers – are equally responsible for ensuring good patient outcomes
COMMUNICATE EFFECTIVELY

- distribute needed information to team members and update the shared mental model
- Use closed loop communication
- Be assertive, not aggressive or submissive
- Avoid personal attacks
- Resolve conflict
- Maintain relationships
- Facilitate collaborative efforts working towards a common goal
- Cross (double) check

CALL FOR HELP EARLY

- Be aware of barriers to asking for help (e.g. fear of criticism or losing face)
- Set predefined criteria for asking for help
- Call for help early
- Mobilize all available resources

ALLOCATE ATTENTION WISELY – AVOID FIXATION

- Be aware of ‘fixation error’ that reduces situational awareness
- Prioritize tasks and focus on the most important task at hand
- Delegate tasks to others
- Use all available information

DISTRIBUTE THE WORKLOAD – MONITOR AND SUPPORT TEAM MEMBERS

- Team Leader stands back whenever possible to maintain situational awareness and oversee the team
- Assign tasks according to the defined roles of the team
- Team Leader supports team members in their tasks

Reference: