



Currents

in Emergency Cardiovascular Care

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Highlights of the 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

This special issue of *Currents* summarizes the changes contained in the 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, published in the Dec 13, 2005, issue of the AHA journal *Circulation*. This edition of *Currents* does not replace the 2005 AHA Guidelines for CPR and ECC. It highlights major changes and provides background information and detailed explanations. It will be helpful to instructors and students in courses offered before new training materials are available. The complete 2005 guidelines document offers instructors and clinicians additional details about the recommendations for CPR and ECC.

This issue of *Currents* contains 3 major sections relevant to the AHA ECC courses:

1. Major Changes Affecting All Rescuers
2. Changes in Lay Rescuer CPR
3. Changes in Healthcare Provider Basic and Advanced Life Support

The **Major Changes** section highlights the most important new recommendations that affect all courses (except newborn resuscitation) and all rescuers. The **Lay Rescuer CPR** section highlights changes for instructors and participants in lay rescuer CPR courses, including first aid. It does not include extensive science background. The **Healthcare Provider** section includes information about the evidence evaluation process on which the new guidelines are based. It highlights

the major changes for basic life support (BLS) for healthcare providers (HCP), defibrillation, advanced cardiovascular life support (ACLS), acute coronary syndromes (ACS), stroke, pediatric advanced life support (PALS), and neonatal resuscitation. The **HCP** section includes more detailed science support for new recommendations than in the lay rescuer section.

This issue of *Currents* does not contain references to the studies used in evidence evaluation for the guidelines recommendations. For detailed references see the 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (*Circulation*. 2005; 112:IV-1–IV-211). Algorithms and drug information from the 2005 guidelines are also included in the 2006 *Handbook of Emergency Cardiovascular Care* (ECC Handbook).

The Challenge: Simplify Resuscitation Training and Improve Effectiveness

Coronary heart disease is responsible for an estimated 330 000 out-of-hospital and emergency department (ED) deaths in the United States each year. Most people accept that statistic as an estimate of the frequency of out-of-hospital and ED sudden cardiac arrest (SCA). This estimate, however, is incomplete. At present SCA is not reported as a distinct event to the Centers for Disease Control and Prevention (CDC) National Center for Vital Statistics. When the CDC begins to record reports of SCA, we will have a better understanding of the incidence of this leading cause of death and the impact of interventions.

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Many victims of SCA demonstrate ventricular fibrillation (VF) at some point in their arrest. Treatment of VF SCA requires early CPR and shock delivery with a defibrillator. High-quality bystander CPR can double or triple survival rates from cardiac arrest. Unfortunately fewer than one third of victims of SCA receive bystander CPR, and even fewer receive high-quality CPR. A major purpose of the 2005 AHA Guidelines for CPR and ECC and all the changes in the AHA training materials is to improve survival from cardiac arrest by increasing the number of victims of cardiac arrest who receive early, high-quality CPR.

Survival for out-of-hospital cardiac arrest averages 6.4% or less in most reports from the United States and Canada. Multiple factors contribute to this low rate of survival, and each of these factors can be difficult to control in clinical studies in the out-of-hospital setting. As a result, many studies use short-term outcomes such as return of spontaneous circulation or survival to hospital admission, rather than long-term outcomes such as neurologically intact survival to hospital discharge. These mixed outcomes make it difficult to judge

if the results of a study are applicable to all patients or victims in all emergency response systems. Despite these challenges, resuscitation research must strive to identify treatments that increase the number of SCA victims who leave the hospital alive with normal brain function.

Some community lay rescuer programs have reported high survival rates from SCA because they provide early CPR and early defibrillation using computerized automated external defibrillators (AEDs) that can be operated by trained lay rescuers. These lay rescuer AED programs can serve as models for improving responses to cardiac arrest in other communities. The North American Public Access Defibrillation trial showed that organized community lay rescuer CPR and AED programs improved survival to hospital discharge for victims with witnessed VF SCA. In addition, lay rescuer and first responder CPR and AED programs in airports and casinos and with police officers have reported survival rates from witnessed VF SCA as high as 49% to 74%. These programs teach us the importance of a planned and practiced response and rescuer training.

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MAJOR CHANGES AFFECTING ALL RESCUERS

The 5 major changes in the 2005 guidelines are these:

- Emphasis on, and recommendations to improve, delivery of effective chest compressions
- A single compression-to-ventilation ratio for all single rescuers for all victims (except newborns)
- Recommendation that each rescue breath be given over 1 second and should produce visible chest rise
- A new recommendation that single shocks, followed by immediate CPR, be used to attempt defibrillation for VF cardiac arrest. Rhythm checks should be performed every 2 minutes.
- Endorsement of the 2003 ILCOR recommendation for use of AEDs in children 1 to 8 years old (and older); use a child dose-reduction system if available.

This section presents an overview of these major changes. The changes are also discussed in the sections for lay rescuers and healthcare providers.

Emphasis on Effective Chest Compressions

2005 (New): Effective chest compressions produce blood flow during CPR (Class I). The guidelines note the following about chest compressions during CPR:

- To give effective chest compressions, all rescuers should “push hard and push fast.” Compress the chest at a rate of about 100 compressions per minute for all victims (except newborns).
- Allow the chest to recoil (return to normal position) completely after each compression, and use approximately equal compression and relaxation times.
- Try to limit interruptions in chest compressions. Every time you stop chest compressions, blood flow stops.

2000 (Old): Importance of quality and rate of chest compressions, importance of complete chest wall recoil, and need to

minimize interruption of chest compressions were not emphasized.

Why: When cardiac arrest is present, there is no blood flow. Chest compressions create a small amount of blood flow to the vital organs, such as the brain and heart. The better the chest compressions performed (ie, with adequate rate and depth and allowing complete chest recoil), the more blood flow they produce. Chest compressions that are too shallow or too slow do not deliver as much blood flow as possible to vital organs. When chest compressions are interrupted, blood flow stops. Every time chest compressions begin again, the first few compressions are not as effective as the later compressions. The more interruptions in chest compressions, the worse the victim’s chance of survival from cardiac arrest.

Studies of actual resuscitation events have shown that half of chest compressions given by professional rescuers are too shallow, and chest compressions are interrupted too often during CPR. The new recommendations remind rescuers to give chest compressions that are fast enough and deep enough. They also remind rescuers to minimize interruptions in chest compressions.

Rescuers are told to let the chest come back to normal position after each compression because during chest wall recoil blood refills the heart. If the rescuer does not allow the chest to recoil or reexpand after each compression, blood flow during the next compression will be reduced because the heart has not filled with adequate blood before the compression. More information about chest compressions in adults, children, and infants is in the basic life support section, below.

One Universal Compression-to-Ventilation Ratio for All Lone Rescuers

2005 (New): The AHA recommends a compression-to-ventilation ratio of 30:2 for all lone (single) rescuers to use for all victims from infants (excluding newborns) through adults. This recommendation applies to all lay rescuers and to all healthcare providers who perform 1-rescuer CPR.

Information about 2-rescuer CPR, a technique not typically taught to lay rescuers, is in the third section, “Healthcare Provider Basic and Advanced Life Support.”

2000 (Old): For adult CPR, a 15:2 compression-to-ventilation ratio was recommended. For infant and child CPR, a 5:1 compression-to-ventilation ratio was recommended.

Why: The science experts wanted to simplify CPR information so that more rescuers would learn, remember, and perform better CPR. They also wanted to ensure that all rescuers would deliver longer series of uninterrupted chest compressions. Although research has not identified an ideal compression-to-ventilation ratio, the higher the compression-to-ventilation ratio, the more chest compressions are given in a series during CPR. This change should increase blood flow to the heart, brain, and other vital organs.

During the first minutes of VF SCA, ventilation (ie, rescue breaths) is probably not as important as compressions. Ventilation, however, *is* important for victims of hypoxic arrest and after the first minutes of any arrest. Most infants and children and most victims of drowning, drug overdose, and trauma who develop cardiac arrest are hypoxic. These victims have the best chance of survival if they receive both chest compressions and ventilations. Therefore, chest-compression-only CPR was not recommended as the preferred CPR technique for lay rescuers. The experts concluded that the combination of compressions and ventilations will be most likely to give the best outcome for all victims of cardiac arrest.

For further information see “Lay Rescuer CPR” and “BLS for Healthcare Providers,” below.

Recommendations for 1-Second Breaths During All CPR

2005 (New): Each rescue breath should be given over 1 second (Class IIa). This recommendation applies to all rescuers. Each rescue breath *should make the chest rise* (rescuers should be able to see the chest rise). All rescuers should give the recommended number of rescue breaths. All rescuers should avoid delivering too many breaths (more than the number recommended) or breaths that are too large or too forceful.

2000 (Old): Many different tidal volumes were recommended for rescue breaths with

and without oxygen. Breaths were to be delivered in 1 second or over 1 to 2 seconds.

Why: During CPR, blood flow to the lungs is much less than normal, so the victim needs less ventilation than normal. Rescue breaths can safely be given in 1 second. In fact, during cycles of CPR, it is important to limit the time used to deliver rescue breaths to reduce interruptions in chest compressions. Rescue breaths given during CPR increase pressure in the chest. This pressure reduces the amount of blood that refills the heart and in turn reduces the blood flow generated by the next group of chest compressions. For all of these reasons, hyperventilation (too many breaths or too large a volume) is not necessary, and may be harmful because it can actually reduce the blood flow generated by chest compressions. In addition, delivery of large and forceful breaths may cause gastric inflation and its complications.

Attempted Defibrillation: 1 Shock, Then Immediate CPR

2005 (New): When attempting defibrillation, all rescuers should deliver 1 shock followed by immediate CPR, beginning with chest compressions. All rescuers should check the victim's rhythm after giving about 5 cycles (about 2 minutes) of CPR. Once AEDs are reprogrammed by the manufacturers, they should prompt rescuers to allow a rhythm check every 2 minutes.

2000 (Old): For treatment of cardiac arrest with a "shockable" rhythm, rescuers delivered up to 3 shocks without any CPR between the shocks. Rescuers checked the rhythm before and after delivering shocks.

Why: The rationale for this new protocol is based on 3 findings:

1. The rhythm analysis by current AEDs after each shock typically results in delays of 37 seconds or even longer before the delivery of the first post-shock compression. Such long interruptions in compressions can be harmful (see information above and Figure 1).
2. With most defibrillators now available, the first shock eliminates VF more than 85% of the time. In cases where the first shock fails, resumption of CPR is likely to confer a greater value than another shock.

3. Even when a shock eliminates VF, it takes several minutes for a normal heart rhythm to return and more time for the heart to create blood flow. A brief period of chest compressions can deliver oxygen and sources of energy to the heart, increasing the likelihood that the heart will be able to effectively pump blood after the shock. There is no evidence that chest compressions immediately after defibrillation will provoke recurrent VF.

We anticipate that AED manufacturers will reprogram AEDs to support this recommendation. The AHA encourages AED manufacturers to develop devices that can analyze the victim's heart rhythm without interrupting chest compressions.

Reaffirmation of 2003 ILCOR Statement: AEDs Recommended for Children Aged 1 Year and Older

2005 (New): AEDs are recommended for use in children 1 year of age and older. The evidence is insufficient to recommend for or against the use of AEDs in infants under 1 year of age (Class Indeterminate).

For sudden witnessed collapse in a child, use the AED as soon as it is available. For unwitnessed cardiac arrest in the out-of-hospital setting, use the AED after about 5 cycles (about 2 minutes) of CPR. Ideally the AED should be proven (via published studies) to accurately and reliably recognize pediatric shockable rhythms and be capable of delivering a "child" energy dose. Many AEDs are now equipped to deliver smaller doses through the use of smaller child pads or a key or other means to reduce the energy dose. If you are giving CPR to a child (older than 1 year) and the available AED does not have child pads or a way to deliver a smaller dose, use a regular AED with adult pads. **DO NOT** use child pads or a child dose for adult victims of cardiac arrest.

2000 (Old): Since 2003 AEDs have been recommended for children in cardiac arrest 1 to 8 years old.

Why: Some AEDs have been shown to be very accurate in recognizing pediatric shockable rhythms, and some are equipped to deliver energy doses suitable for children. Rescuers should **NOT** use child pads or a child dose for adults in cardiac arrest, however, because the smaller dose is unlikely to defibrillate the adult.

LAY RESCUER CPR

The major changes in the 2005 guidelines recommendations for lay rescuer CPR are the following:

1. If alone with an unresponsive infant or child, give about 5 cycles of compressions and ventilations (about 2 minutes) before leaving the child to phone 911.
2. Do not try to open the airway using a jaw thrust for injured victims—use the head tilt–chin lift for all victims.
3. Take 5 to 10 seconds (no more than 10 seconds) to check for *normal* breathing in an unresponsive adult or for presence or absence of breathing in the unresponsive infant or child.
4. Take a normal (not a deep) breath before giving a rescue breath to a victim.
5. Give each breath over 1 second. Each breath should make the chest rise.
6. If the victim's chest does not rise when the first rescue breath is delivered, perform the head tilt–chin lift again before giving the second breath.
7. Do not check for signs of circulation. After delivery of 2 rescue breaths, immediately begin chest compressions (and cycles of compressions and rescue breaths).
8. No teaching of rescue breathing without chest compressions (exception: rescue breathing is taught in the Heartsaver Pediatric First Aid Course).
9. Use the same 30:2 compression-to-ventilation ratio for all victims.
10. For children, use 1 or 2 hands to perform chest compressions and compress at the nipple line; for infants, compress with 2 fingers on the breastbone just below the nipple line.
11. When you use an AED, you will give 1 shock followed by immediate CPR, beginning with chest compressions. Rhythm checks will be performed every 2 minutes.
12. Actions for relief of choking (severe airway obstruction) have been simplified.
13. New first aid recommendations have been developed with more information included about stabilization of the head and neck in injured victims.

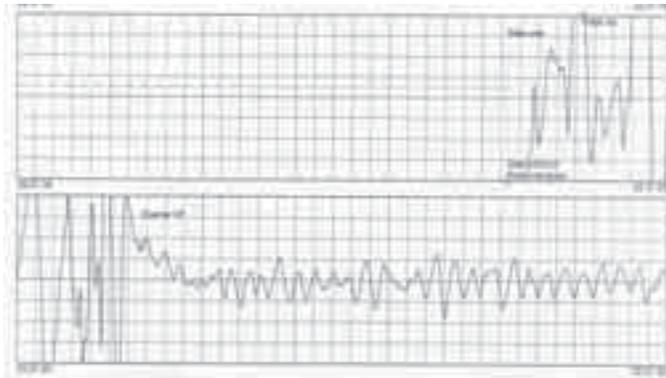


Figure 1-A

The first segments were recorded when the AED was turned on and attached (time is 22:37:22). The rhythm is labeled as “coarse VF.”

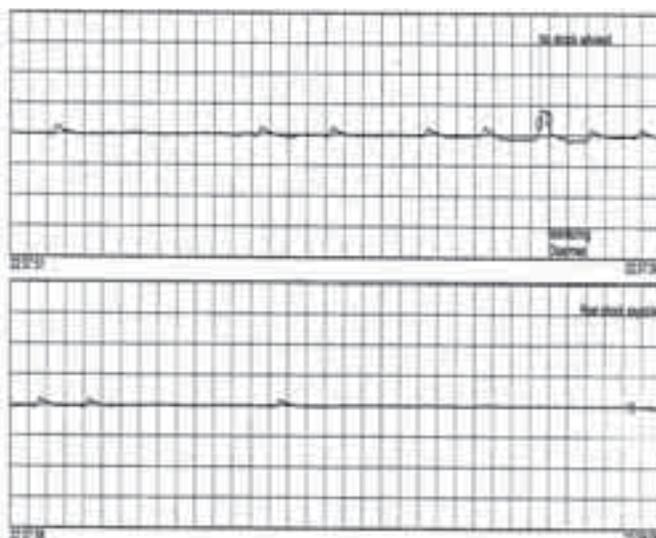


Figure 1-C

This third ECG segment depicts the post-shock rhythm through the next 21 seconds. Asystole is present, and the AED is analyzing the rhythm so no CPR is provided and there is no blood flow.

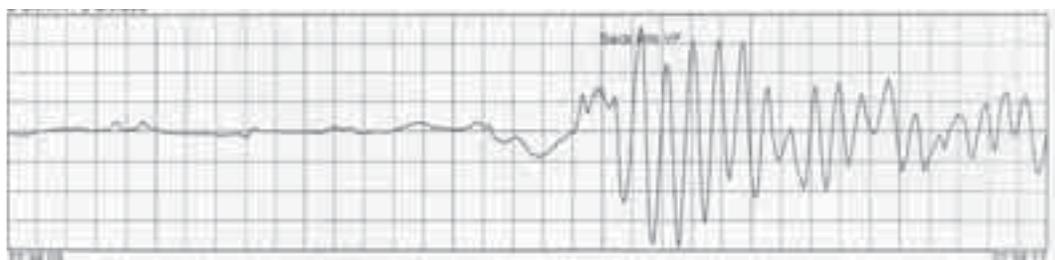


Figure 1-D

This fourth segment depicts refrillation (at 22:38:09), 25 seconds after the first shock successfully eliminated VF. Note that no CPR was performed during the 25 seconds. The AED then analyzes the rhythm and recommends a shock. A shock is delivered (at 22:38:43), asystole follows, and the AED then analyzes those rhythms. CPR is finally recommended and begins at 22:39:01, a total of 1 minute, 17 seconds after the first shock. The victim survived.

Figure 1

ECG series shows the negative effect of delaying chest compressions after shock delivery. This continuous series was downloaded from an AED used for resuscitation of a victim of sudden cardiac arrest on a golf course. The ECG begins at 22:37:22 when the AED is attached and continues through 22:39:01 when CPR is resumed. The victim survived the SCA.

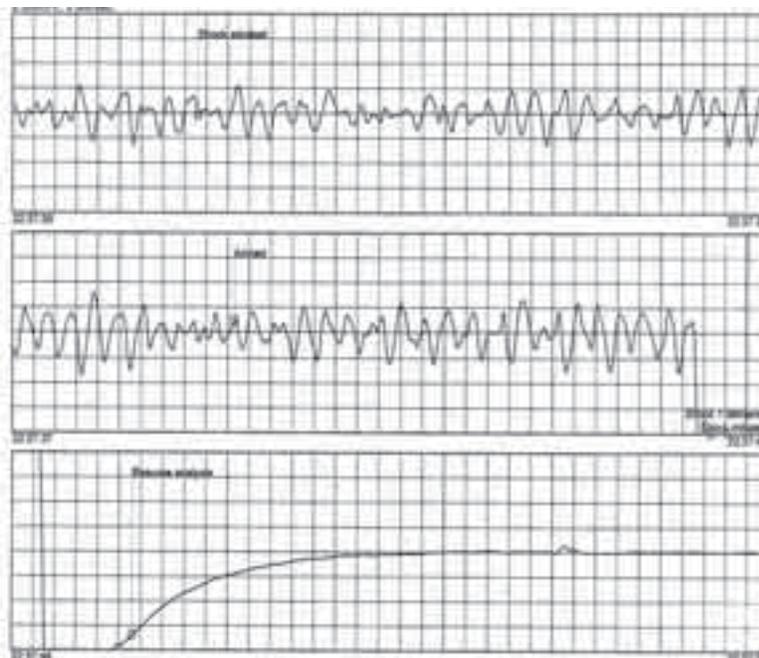


Figure 1-B

In this second series, a shock is advised and is delivered (at 22:37:44), 22 seconds after the pads were attached. The shock eliminates the VF; the initial post-shock rhythm is asystole. The AED then analyzes the rhythm after the first shock.

These changes are designed to simplify lay rescuer training and to increase the number of uninterrupted chest compressions delivered to the victim of cardiac arrest. More information about these changes appears below. The major changes summarized earlier are highlighted in this section for completeness.

What did NOT change for lay rescuers:

- Checking for response
- Location for hand placement for chest compressions in adults
- Compression rate
- Compression depth for adults, infants, or children (although compression depth for infants and children is no longer listed in inches; it is described only as 1/3 to 1/2 the depth of the chest)
- Ages used for infant, child, and adult CPR recommendations
- Key steps for relief of foreign-body airway obstruction (FBAO; choking) for infants, children, or adults
- First aid recommendations (minor rewording about stabilization of the head and neck for injured victims)

Lone Rescuers of Infants and Children

Lay Rescuers Give 5 Cycles (About 2 Minutes) of CPR for Infant or Child Before Call

2005 (New): For unresponsive infants and children, the lone rescuer should perform 5 cycles (about 2 minutes) of CPR before phoning 911 and, for the child, retrieving the AED (Table 1).

2000 (Old): The lay rescuer alone with an unresponsive infant or child was taught to give about 1 minute of CPR before leaving the child to phone 911.

Why: In infants and children, hypoxic cardiac arrest is the most common type of arrest. The 5 cycles of (30:2) compressions and ventilations or about 2 minutes of CPR will deliver some oxygen to the victim’s heart, brain, and other vital organs. Some infants and children may respond to that initial CPR. After the 5 cycles (about 2 minutes) the lone lay rescuer should leave the child to telephone the emergency response number (911).

Airway and Breathing

Lay Rescuers Do Not Perform Jaw Thrust

2005 (New): The lay rescuer should use the head tilt–chin lift to open the airway in all unresponsive victims even if the victim is injured.

2000 (Old): Lay rescuers were taught to use a jaw thrust to open the airway of injured victims.

Why: It is very difficult to open the airway with a jaw thrust. In addition, all methods of opening the airway can produce movement of an injured spine, so the jaw thrust may not be any safer than the head tilt–chin lift. The lay rescuer must be able to open the airway for the victim who does not respond. To simplify instruction and ensure that the lay rescuer can open the airway, only the head tilt–chin lift will be taught to lay rescuers.

Check for Breathing in Adults, Children, and Infants

2005 (New): If the lay rescuer finds an unresponsive adult victim, the lay rescuer should open the airway and take 5 to 10 seconds (but no more than 10 seconds) to check for normal breathing. If no normal breathing is present, the rescuer should give 2 rescue breaths.

Lay rescuers of unresponsive infants and children should take 5 to 10 seconds (but no more than 10 seconds) to check for presence or absence of breathing before giving 2 rescue breaths.

2000 (Old): Lay rescuers checked for presence or absence of normal breathing for all victims.

Why: As noted in 2000, adult victims of SCA may gasp for the first minutes after collapse, and lay rescuers may believe that the gasping victim is breathing. Rescuers should treat gasping as no breathing. Unresponsive victims who are gasping are probably in cardiac arrest and need CPR. EMS dispatchers report that when they tell bystanders to look for absence

of “normal” breathing, the word “normal” helps bystanders better identify adult victims who need CPR.

For example, when EMS dispatchers ask bystanders if the victim is breathing, the bystanders often say yes even when a victim is only gasping. If the dispatcher asks if the same victim is breathing “normally,” bystanders will say no and will be able to recognize that the victim needs CPR. It is important that lay rescuers recognize when CPR is needed.

Gasping does not occur as often in infants and children in cardiac arrest as it does in adults. Children may demonstrate breathing patterns such as rapid breathing or grunting that are not normal but are adequate. For

TABLE 1. Summary of Lay Rescuer CPR for Adults, Children, and Infants
(Newborn/Neonatal information not included)

Step/Action	Adult: 8 years and older	Child: 1 to 8 years	Infant: Under 1 year
Airway	Head tilt–chin lift		
Breaths Initial	2 breaths at 1 second/breath		
Foreign-body airway obstruction	Abdominal thrust		Back slaps and chest thrusts
Compressions			
Compression landmarks	In the center of the chest, between nipples		Just below nipple line
Compression method Push hard and fast Allow complete recoil	2 Hands: Heel of 1 hand, second hand on top	2 Hands: Heel of 1 hand with second on top or 1 Hand: Heel of 1 hand only	2 fingers
Compression depth	1½ to 2 inches	About 1/3 to 1/2 the depth of the chest	
Compression rate	About 100/min		
Compression-ventilation ratio	30:2		
Defibrillation			
AED	Use adult pads. Do not use child pads/child system.	Use after 5 cycles of CPR. Use child pads/system for child 1 to 8 years if available. If not, use adult AED and pads.	No recommendation for infants <1 year of age

this reason, lay rescuers of infants and children are not taught to look for normal or abnormal breathing; they should look for presence or absence of breathing. They should be able to determine within 10 seconds if the infant or child is breathing or not.

Rescuers Should Take a Normal Breath Before Giving a Rescue Breath

2005 (New): All rescuers should take a normal breath (not a deep breath) before giving mouth-to-mouth or mouth-to-barrier device rescue breaths.

2000 (Old): Rescuers were instructed to take a deep breath before giving a mouth-to-mouth or mouth-to-mask rescue breath.

Why: Taking a deep breath before giving a rescue breath is unnecessary. The rescuer should be able to give a breath that makes the victim's chest rise without taking a deep breath.

Give Each Rescue Breath Over 1 Second

2005 (New): All rescuers should deliver each rescue breath (with or without a barrier device) over 1 second.

2000 (Old): Rescuers were told to deliver some breaths over 1 to 2 seconds.

Why: Rescue breaths can be given in 1 second. The shorter the time needed to deliver breaths, the faster rescuers can resume chest compressions. Longer breaths can reduce blood return to the heart so it reduces refilling of the heart with blood; this will decrease the blood flow produced by the next set of chest compressions.

Reopening of Airway if First Breath Does Not Make Chest Rise

2005 (New): When lay rescuers give 2 rescue breaths, each rescue breath should make the chest rise (ie, the rescuer should be able to see the chest rise). If the first breath does not make the chest rise, the rescuer should perform another head tilt–chin lift before attempting to deliver the second rescue breath.

2000 (Old): Although rescuers were told that each breath should make the chest rise, lay rescuers were given no instructions about what to do if the rescue breath did not make the chest rise.

Why: The purpose of this change is to give clear instructions for lay rescuers who note that the victim's chest does not rise when the first rescue breath is given. Rescue breaths are very important for the nonbreathing infant or child because infants and children usually do not breathe well even before cardiac arrest develops. The rescuer should give 2 effective breaths (ie, breaths that make the chest rise). If the chest does not rise after the first breath, performing the head tilt–chin lift again may open the airway. The lay rescuer should not try more than 2 times to give a rescue breath that makes the chest rise because it is important to give chest compressions.

Simplifying Lay Rescuer CPR

No Lay Rescuer Check for Signs of Circulation

2005 (New): After delivering the first 2 rescue breaths, the lay rescuer should immediately begin cycles of 30 chest compressions and 2 rescue breaths. The lay rescuer should continue compressions and rescue breaths until an AED arrives, the victim begins to move, or professional responders take over.

2000 (Old): After delivering 2 rescue breaths the lay rescuer checked for signs of circulation (breathing, coughing, or movement). If there were no signs of circulation, the rescuer was taught to begin chest compressions. Lay rescuers were advised to recheck for signs of circulation every few minutes.

Why: In 2000 the AHA stopped recommending that lay rescuers check for a pulse because data showed that lay rescuers could not do so reliably within 10 seconds. Lay rescuers were instructed to look for signs of circulation. There is no evidence that lay rescuers can accurately assess signs of circulation, however, and this step delays chest compressions. Lay rescuers should not check for signs of circulation and should not interrupt chest compressions to recheck for signs of circulation.

No Rescue Breathing Without Chest Compressions

2005 (New): Immediately after delivering the first 2 rescue breaths, the lay rescuer should begin cycles of 30 chest compressions and 2 rescue breaths. The lay rescuer will not be taught rescue breathing

without chest compressions (except in the AHA Heartsaver Pediatric First Aid Course).

2000 (Old): After delivery of 2 rescue breaths, the lay rescuer checked for signs of circulation (breathing, coughing, or movement). The lay rescuer was instructed to give rescue breathing without chest compressions to victims with signs of circulation but no normal breathing.

Why: The elimination of rescue breathing without chest compressions will reduce the number of CPR skills lay rescuers must learn, remember, and perform. This change also eliminates the need to further assess the victim after the initial rescue breaths, reducing the time delay before delivering the first chest compressions.

30:2 Compression-to-Ventilation Ratio for All Victims

2005 (New): The AHA recommends a compression-to-ventilation ratio of 30:2 for all lay rescuers to use for all victims from infants (excluding newborns) through adults.

2000 (Old): For adult CPR a 15:2 compression-to-ventilation ratio was recommended. For infant and child CPR a 5:1 compression-to-ventilation ratio was recommended.

Why: The science experts wanted to simplify CPR information so that more rescuers would learn, remember, and perform CPR. In addition, they wanted to ensure that all rescuers would deliver longer series of chest compressions. This change should increase blood flow to the heart, brain, and other vital organs.

Simplified Instructions for Compressions of Child and Infant

2005 (New): Rescuers may use 1 or 2 hands to give chest compressions for children. Rescuers should press on the breastbone at about the nipple line. For compressions for infants, rescuers should press on the breastbone just below the nipple line.

2000 (Old): One-hand chest compressions were recommended over the lower half of the child's sternum and 1 finger-breadth below the nipple line of the infant.

Why: Rescuers and children come in all sizes. For the child, the rescuer should use 1 or 2 hands as needed to compress the chest about one third to one half its depth. If 2 hands are used, the hand placement

is the same as the hand placement used for chest compressions for adult victims (the difference is in the depth of chest compression). This change was made to simplify instruction.

For the infant, the rescuer should use 2 fingers to press on the breastbone just below the nipple line. This change was made because rescuers and infants come in many sizes, and the use of 1 rescuer finger width resulted in compressions at different places. This change was made to simplify instruction.

Giving Shocks With AEDs: Give 1 Shock Then CPR

2005 (New): When using an AED, all rescuers should deliver 1 shock followed by immediate CPR. The CPR should begin with chest compressions. All rescuers should allow the AED to check the victim's rhythm again after about 5 cycles (about 2 minutes) of CPR.

2000 (Old): For treatment of cardiac arrest with a "shockable" rhythm, rescuers delivered up to 3 shocks without any CPR between the shocks. After 3 shocks rescuers would give about 1 minute of CPR and then check the rhythm.

Why: When AEDs recheck the rhythm after a shock, this delays chest compressions. Most new defibrillators eliminate VF with 1 shock, so VF probably won't be present immediately after a shock is delivered. Thus it is difficult to justify interruption of chest compressions to search for VF when it is not likely to be present. In addition, after a shock eliminates VF, most hearts do not pump blood effectively for a few minutes after the shock. Chest compressions are needed during this time to provide blood flow to the heart, brain, and other organs. If VF does remain after a shock, chest compressions will deliver oxygen to the heart. This will make the VF more likely to be eliminated by the next shock.

Simplified Instructions for Relief of Foreign-Body Airway Obstruction

2005 (New): Terminology used to separate choking victims who require intervention (eg, abdominal thrusts) from those who do not has been simplified to refer only to signs of *mild* versus *severe* airway obstruction. Rescuers should act if they see signs of *severe* obstruction: poor air exchange and

increased breathing difficulty, a silent cough, cyanosis, or inability to speak or breathe. Rescuers should ask 1 question: "Are you choking?" If the victim nods yes, help is needed. Other lay rescuer treatment of choking has not changed.

2000 (Old): Rescuers were taught to recognize partial airway obstruction with good air exchange, partial airway obstruction with poor air exchange, and complete airway obstruction. Rescuers were taught to ask the victim 2 questions: "Are you choking?" and "Can you speak?"

Why: The goal of these revisions is simplification. The goal of using "mild" versus "severe" airway obstruction is to help the rescuer know when to act. The elimination of 1 question simplifies lay rescuer action.

First Aid

These are the second evidence-based guidelines for first aid and the first guidelines cosponsored by the American Heart Association and the American Red Cross. First aid guidelines describe recommendations for assessments and interventions intended for use by bystanders or victims who have no medical equipment. The topics reviewed in these first aid guidelines are:

- Use of oxygen (new in 2005)
- Use of inhalers (new in 2005)
- Use of epinephrine auto-injectors (new in 2005)
- Seizures (reviewed in 2000 and 2005)
- Bleeding (reviewed in 2000 and 2005)
- Wounds and abrasions (new in 2005)
- Burns—thermal and electrical (reviewed in 2000 and 2005)
- Musculoskeletal trauma (reviewed in 2000 and 2005)
- Dental injuries (new in 2005)
- Snakebite (new in 2005)
- Cold emergencies—hypothermia and frostbite (new in 2005)
- Poisoning—chemical and ingested (reviewed in 2000 and 2005)

In general the recommendations made in 2000 were confirmed in 2005. The one exception was the modification of

wording used for spine stabilization for injured victims and the recovery position recommended for victims with possible spine injury. The recommendations summarized here highlight the new recommendations and do not include those that confirm the 2000 guidelines.

Not Enough Evidence to Recommend First Aid Use of Oxygen

2005 (New): Evidence is insufficient to recommend for or against the use of oxygen for first aid.

Why: The only published studies about oxygen use involved healthcare providers. There was no evidence about the first aid use of oxygen.

Recommended: Use of Asthma Inhaler and Epinephrine Auto-injector

2005 (New): First aid providers may help victims with asthma use an inhaler prescribed by a physician. First aid providers may help victims with a bad allergic (anaphylactic) reaction use a prescribed epinephrine auto-injector. The first aid provider may administer the epinephrine if the provider is trained to do so, the state law allows it, and the victim is unable to administer it.

Why: Deaths from asthma are increasing, and drugs in inhalers can reduce breathing difficulties from asthma. Epinephrine given by auto-injector can lessen signs and symptoms of a bad allergic reaction. Asthma inhalers and the epinephrine auto-injector are unlikely to cause harm in someone with breathing difficulties from asthma or an allergic reaction, and they may prevent life-threatening complications.

Treatment of Wounds and Abrasions

2005 (New): First aid providers should wash wounds and abrasions with clean running water for 5 minutes or longer. They should wash the wounds or abrasions until the wound shows no sign of foreign matter. If running water is not available, the rescuer can use any source of clean water. If the wound is an abrasion or is superficial, the first aid provider can apply an antibiotic ointment or cream.

Why: Clean running water can work well to clean wounds and prevent infection and help healing. Small superficial wounds appear to heal best if treated with an antibiotic cream or lotion.

Spine Stabilization for Injured Victims

2005 (New): First aid providers should use manual spine stabilization (ie, stabilization with hands rather than devices) and should avoid using immobilizing devices. Rescuers should use the head tilt–chin lift to open the airway (see information above).

If you suspect a spine injury, it is best not to move the victim. If you are alone and must leave the unresponsive victim to get help, extend one of the victim's arms above the head. Then roll the victim's body to that side so that the victim's head rests on the extended arm. Bend the legs to stabilize the victim (Class IIb).

2000 (Old): If the first aid provider suspected that the victim had a spinal cord injury, the provider was instructed to immobilize the victim's head, neck, and trunk, and use the jaw thrust to open the airway.

Why: Immobilization devices can interfere with opening the airway, and there is no evidence that first aid providers can use devices correctly. Even the jaw thrust can move the injured spine, so it is no longer recommended for the first aid rescuer.

The recovery position described above may support the head and neck so you should use it when you must leave the victim with a suspected spine injury.

Treatment of an Avulsed Tooth

2005 (New): If a tooth is avulsed, first aid providers should clean the tooth socket and use pressure to stop the bleeding. Providers should handle the tooth by the crown (not the root that was in the gum) and should place the tooth in milk and consult the victim's dentist.

Why: Placing the tooth in milk may help preserve the tooth until a dentist can reimplant it. The first aid provider should not try to reinsert the tooth because it can injure the victim or harm the tooth.

Treatment of Snakebites

2005 (New): If a victim's arm or leg is bitten by an elapid (coral) snake, the first aid provider should wrap the entire extremity with an elastic bandage. The bandage should

immobilize the extremity. It should be wrapped snugly enough to allow 1 finger to slip between the bandage and the skin. Insufficient evidence exists to recommend this bandage for a non-elapid snakebite. The first aid provider should not try to put any suction on a snakebite.

Why: A snug bandage wrapped around the entire extremity has been shown to reduce venom uptake from an elapid (coral) snakebite. No evidence has shown that a pressure bandage reduces venom uptake after non-elapid snakebites. Applying suction to a snakebite has no benefit and may cause harm.

Treatment of Cold Emergencies

2005 (New): First aid for hypothermia includes moving the victim into a warm environment, removing wet clothing, and wrapping the victim's exposed body surfaces with blankets or clothing. Active rewarming should be used only when the victim is far from a medical facility. A frostbitten area should not be actively warmed if there is any chance of refreezing or if the victim is close to a medical facility.

Why: Little scientific evidence guides first aid recommendations for hypothermia and frostbite. The recommendations are based on extrapolation from in-hospital studies, clinical experience, and concern for possible complications of rapid rewarming.

Treatment of Poisoning

2005 (New): When poisoning occurs, first aid providers should call the Poison Control Center (800-222-1222). Victims should not drink anything (including milk or water) after ingesting a poison. Providers should not give the victim activated charcoal or syrup of ipecac unless told to do so by the Poison Control Center. Rescuers should brush chemical poisons off the skin and then wash the skin with large amounts of water.

Why: No human studies have shown a benefit to administration of water or milk after poisoning, and they may increase the risk of vomiting. Not enough evidence exists to recommend use of activated charcoal or ipecac unless advised by the Poison Control Center.

This section highlights the major changes in the 2005 guidelines that will affect healthcare providers who give basic and advanced life support. Advanced life support includes advanced cardiovascular life support (ACLS), pediatric advanced life support (PALS), and neonatal resuscitation. This section includes background information about the evidence evaluation and guidelines development process and more detailed scientific rationale for the changes. The major changes that affect all providers are highlighted in the BLS section with more information than was provided in the Major Changes overview or the Lay Rescuer CPR section. Further information is included in the Advanced Life Support section.

The Process

International Evidence Evaluation

The 2005 AHA Guidelines for CPR and ECC¹ are based on the largest review of resuscitation literature ever published. The process was organized by the International Liaison Committee on Resuscitation (ILCOR) and involved 380 international resuscitation experts over a 36-month period.² The scientists met for final debate and discussion in January 2005 at an international conference hosted by the American Heart Association. You can read the worksheets prepared as part of the evidence evaluation process at the AHA website (www.C2005.org). This evidence evaluation process is described in the Introduction of the 2005 guidelines. Further details appear in an editorial by Zaritsky and Morley³ that accompanies the ILCOR summary of the evidence evaluation, published in the November supplement of the AHA journal *Circulation*.

The AHA ECC volunteers and the ILCOR representatives developed and used a rigorous process of disclosure and management of potential conflicts of interest. This is summarized in an editorial by Billi *et al.*⁴ in the 2005 guidelines supplement published in *Circulation* in December.

Changes include simplifying and emphasizing the role of basic life support as fundamental to improving survival from cardiac arrest. All rescuers must deliver high-quality CPR: they must provide compressions of adequate depth and number, allow adequate chest recoil after each compression, and minimize interruptions in chest compressions. The most important message in the 2005 guidelines is that high-quality (ie, properly performed) CPR will save lives, and all victims of cardiac arrest should receive high-quality CPR.

References

1. American Heart Association. 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. International Consensus on Science. *Circulation*. 2005; 112:IV-1–IV-211.
2. ILCOR 2005 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. *Circulation*. 2005; 112: III-1–III-125.
3. Zaritsky A, Morley P. The evidence evaluation process for the 2005 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Circulation*. 2005; 112: III-128–III-130.
4. Billi JE, Eigel B, Montgomery WH, Nadkarni V, Hazinski MF. Management of conflict of interest issues in the American Heart Association emergency cardiovascular care committee activities 2000–2005. *Circulation*. 2005; 112:IV-204–IV-205.

Classes of Recommendation

Classes of Recommendations are listed in the guidelines to indicate the strength of recommendations. These classes represent the integration of the strength of the scientific evidence with application factors such as the magnitude of benefit, usefulness or efficacy, cost, educational and training challenges, and difficulties in implementation.

For Class I recommendations, high-level prospective studies support the action or therapy, and the benefit of the action or therapy substantially outweighs the potential for harm. For Class IIa recommendations, the weight of evidence supports the action or therapy, and the therapy is considered acceptable and useful. Recommendations are generally labeled Class IIb when the evidence documented only short-term benefits from the therapy (eg, amiodarone

for pulseless VF cardiac arrest) or when positive results were documented with lower levels of evidence.

Class IIb recommendations fall into 2 categories: (1) optional and (2) recommended by the experts despite the absence of high-level supporting evidence. Optional interventions are identified by terms such as “can be considered” or “may be useful.” Interventions that the experts believe should be carried out are identified with terms such as “is recommended.”

Recommendations for EMS Dispatchers

EMS Dispatcher CPR Instruction

2005 (New): Dispatchers should receive appropriate training to provide CPR instructions to callers by telephone (Class IIa). Dispatchers should help bystanders to recognize that victims with occasional gasps are likely victims of cardiac arrest, to increase the likelihood that victims of cardiac arrest will receive bystander CPR (Class IIb). When callers describe a victim of likely VF SCA, telephone instruction in chest compressions alone may be preferable (Class IIb). Dispatchers who provide telephone CPR instructions to bystanders treating infants and children and adult victims with a high likelihood of a hypoxic (asphyxial) cause of arrest (eg, drowning victims) should give directions for rescue breaths and chest compressions.

2000 (Old): The previous guidelines recommended formal dispatcher training and use of dispatch protocols to provide pre-arrival instructions. For simplicity, dispatcher instructions for chest-compression-only CPR were recommended (Class IIa), with request for further evaluation.

Why: Dispatcher CPR instructions increase the likelihood of bystander CPR. Although chest compressions alone may be effective for victims of VF SCA, instructions in chest compressions and rescue breaths will likely be needed for victims of hypoxic (asphyxial) arrest. When dispatchers question the bystander to determine if cardiac arrest is present, dispatchers must help the bystander distinguish between effective breathing and gasps. If an unresponsive victim is gasping, that victim should be treated as though cardiac arrest is present, and the rescuer should be instructed to give CPR (see below).

Dispatchers to Recommend Aspirin for Acute Coronary Syndromes

2005 (New): Dispatchers and EMS providers should be trained to recognize symptoms of ACS. Dispatchers should advise patients with no history of aspirin allergy or signs of active or recent gastrointestinal bleeding to chew an aspirin (160 mg to 325 mg) while awaiting the arrival of EMS providers (Class IIa).

2000 (Old): EMS providers (but not dispatchers) were instructed to give aspirin as soon as possible to all patients with suspected ACS (unless the patient had an ASA allergy).

Why: Early administration of aspirin has been associated with decreased mortality rates in several clinical trials. Many studies have demonstrated the safety of aspirin administration.

Recommendations for EMS Systems

Improvement in Response Intervals When Feasible

2005 (New): EMS systems should evaluate their protocols for cardiac arrest patients and try to shorten response time when feasible (Class I). Each EMS system should measure the rate of survival to hospital discharge for victims of cardiac arrest and use these measurements to document the impact of changes in procedures (Class IIa).

2000 (Old): The guidelines recommended goals for response intervals and programs of quality improvement.

Why: All EMS systems should develop a process of ongoing quality improvement. This process should identify delays in system response and reduce them when feasible.

EMS Medical Directors May Recommend CPR Before Shock

2005 (New): EMS system medical directors may consider implementing a protocol that would allow EMS responders to provide about 5 cycles (about 2 minutes) of CPR before attempted defibrillation when the EMS system call-to-response interval is >4 to 5 minutes.

2000 (Old): EMS providers attempted defibrillation as soon as cardiac arrest was identified.

Why: In 2 of 3 studies, when the EMS call-to-response interval was 4 to 5 minutes or longer, a period of 1½ to 3 minutes of CPR before defibrillation was associated with improved survival. For further information see Defibrillation, below.

Basic Life Support for Healthcare Providers

Many of the changes in BLS recommended in 2005 are designed to simplify CPR recommendations (including eliminating differences in technique for different ages when possible), increase the number and quality of chest compressions delivered, and increase the number of uninterrupted chest compressions.

A universal compression-to-ventilation ratio of 30 to 2 is recommended for lone rescuers for victims of all ages (except newborns). This 30:2 compression-to-ventilation ratio also applies to healthcare providers performing 2-rescuer CPR for *adult* victims until an advanced airway (eg, endotracheal tube, esophageal-tracheal combitube [Combitube], or laryngeal mask airway [LMA]) is in place. Once an advanced airway is in place, 2 rescuers should no longer provide cycles of CPR with pauses in compressions to give rescue breaths (see below).

Before an advanced airway is in place, rescuers should perform about 5 cycles of CPR after shock delivery and before the next rhythm check. Once an advanced airway is in place, rescuers should perform about 2 minutes of CPR after shock delivery and before the next rhythm check.

For 2-rescuer infant and child CPR for healthcare providers (and in any courses such as lifeguard CPR where 2-rescuer CPR for infants and children is taught), rescuers should use a 15:2 compression-to-ventilation ratio (see below).

Major changes in BLS for HCP include the following:

- Healthcare provider “child” CPR guidelines now apply to victims 1 year to the onset of puberty.
- Lone healthcare providers should tailor their sequence of actions for the most likely cause of arrest in victims of all ages.
 - ✦ “Phone first” and get the AED and return to start CPR and use the AED for all

adults and any children with out-of-hospital *sudden collapse*.

- ✦ “CPR first” (provide about 5 cycles or 2 minutes of CPR before activating the emergency response number) for unresponsive infants and children (except infants and children with sudden, witnessed collapse) and for all victims of likely *hypoxic* (asphyxial) arrest (eg, drowning, injury, drug overdose).
- Opening the airway remains a priority for an unresponsive trauma victim with suspected cervical spine injury; if a jaw thrust without head extension does not open the airway, healthcare providers should use the head tilt–chin lift maneuver.
- Basic healthcare providers check for “adequate” breathing in adults and presence or absence of breathing in infants and children before giving rescue breaths. Advanced providers will look for “adequate” breathing in victims of all ages and be prepared to support oxygenation and ventilation.
- Healthcare providers may need to try “a couple of times” to reopen the airway and deliver effective breaths (ie, breaths that produce visible chest rise) for infant and child victims.
- Excessive ventilation (too many breaths per minute or breaths that are too large or too forceful) may be harmful and should not be performed.
- Chest compressions are recommended if the infant or child heart rate is less than 60 per minute with signs of poor perfusion despite adequate oxygenation and ventilation. This recommendation was part of the 2000 guidelines but was not emphasized in courses. It will now be emphasized in the courses.
- Rescuers must provide compressions of adequate rate and depth and allow adequate chest recoil with minimal interruptions in chest compressions.
- Use 1 or 2 hands to give chest compressions for a child; press on the sternum at the nipple line. For the infant, press on the sternum just below the nipple line.
- During 2-rescuer infant CPR, the 2 thumb–encircling hands technique should include a thoracic squeeze.

- Healthcare providers should use a 30:2 compression-to-ventilation ratio for 1-rescuer CPR for victims of all ages and for 2-rescuer CPR for adults. Healthcare providers should use a 15:2 compression-to-ventilation ratio for 2-rescuer CPR for infants and children.
- During 2-rescuer CPR with an advanced airway in place, rescuers no longer provide cycles of compressions with pauses for ventilation. The compressor provides continuous compressions and the rescuer providing rescue breaths gives 8 to 10 breaths per minute (1 breath about every 6 to 8 seconds).
- When 2 or more healthcare providers are present during CPR, rescuers should rotate the compressor role every 2 minutes.
- Actions for FBAO relief were simplified.

What did NOT change:

- Checking for response
- Pulse check
- Rescue breathing without chest compressions
- Location of hands or fingers for adult chest compressions
- Compression rate
- Compression depth for adults, infants, or children (note that for infants and children the depth of compression is listed as one third to one half the depth of the chest and is no longer listed in inches)
- Ages for use of infant BLS recommendations

For Healthcare Providers “Child” BLS Guidelines Apply to Onset of Puberty

2005 (New): Child CPR guidelines for *healthcare providers* apply to victims from about 1 year of age to the onset of adolescence or puberty (about 12 to 14 years old), as defined by the presence of secondary sex characteristics (eg, breast development in girls, armpit hair in boys). Hospitals (particularly children’s hospitals) or pediatric intensive care units may choose to extend the use of PALS guidelines to pediatric patients of all ages (generally up to about 16 to 18 years old) rather than use puberty as the cutoff for application of PALS versus ACLS guidelines.

Healthcare providers often will assist lay rescuers in the community. Healthcare providers should be aware that child CPR guidelines for the *lay rescuer* apply to children about 1 to 8 years old (up to about 25 kg or 55 pounds in weight or up to about 127 cm or about 50 inches in height/length). Adult guidelines for the *lay rescuer* apply to victims about 8 years of age and older.

2000 (Old): Child CPR guidelines applied to victims 1 to 8 years old.

Why: There is no single anatomic or physiologic characteristic that distinguishes a “child” victim from an “adult” victim and no scientific evidence that identifies a precise age to begin adult rather than child CPR techniques. The lay rescuer age delineations remain unchanged from those recommended in 2000 for ease of teaching CPR and use of an AED with child pads or a child dose-attenuator system (for victims 1 to 8 years of age).

Healthcare providers will continue to use the cutoff of 8 years old for use of AED child pads or child attenuator system (to reduce the AED dose). However, because hypoxic (asphyxial) arrest remains the most common cause of cardiac arrest in children through adolescence, healthcare providers should apply the “child” CPR guidelines and sequence (eg, CPR first, and 15:2 compression-to-ventilation ratio for 2-rescuer CPR) for victims aged 1 year to the onset of puberty.

Lone Healthcare Provider Should Tailor Sequence for Out-of-Hospital Arrest

2005 (New): In general, the lone healthcare provider will “phone first” (and get an AED if available and then provide CPR and use the AED) for an unresponsive *adult*. In general, the lone healthcare provider will provide “CPR first” (and will activate the emergency response system after about 5 cycles or 2 minutes of CPR) for an unresponsive *infant or child*. The sequence of rescue actions, however, should be tailored to the most likely cause of arrest. If a victim of any age has a *sudden witnessed collapse*, the collapse is likely to be cardiac in origin, and the healthcare provider should activate the emergency response system, get an AED (when available), and return to the victim to provide CPR and use the AED when appropriate (see Defibrillation,

below). The AED should be used as soon as it is available for victims of sudden collapse/SCA (see Box).

If a victim of any age has a likely *hypoxic* (asphyxial) arrest, such as a drowning, the lone healthcare provider should give 5 cycles (about 2 minutes) of CPR before leaving the victim to activate the emergency response system and retrieve the AED.

2000 (Old): Tailoring of provider response to the likely cause of arrest was mentioned in the 2000 Guidelines but was not emphasized in training.

Why: *Sudden* collapse in a victim of any age is likely to be cardiac in origin, and early defibrillation is needed in addition to early CPR. Victims of hypoxic (asphyxial) arrest need immediate CPR, including ventilations and chest compressions, before the lone healthcare provider leaves the victim to phone for help and get the AED.

Opening the Airway and Stabilizing the Spine in a Trauma Victim

2005 (New): The healthcare provider should use the head tilt–chin lift technique to open the airway of a trauma victim unless cervical spine injury is suspected. If a cervical spine injury is suspected, the healthcare provider

should open the airway using a jaw thrust without head extension (Class IIb). If this maneuver does not open the airway, the healthcare provider should use a head tilt–chin lift technique because opening the airway is a priority for the unresponsive trauma victim (Class I).

Healthcare providers should manually stabilize the head and neck rather than use immobilization devices during CPR for victims with suspected spinal injury (Class IIb).

2000 (Old): The jaw thrust without head tilt was taught to both lay rescuers and healthcare providers.

Why: The jaw thrust is a difficult maneuver to learn and to perform; in fact, on many manikins it is impossible to perform. The jaw thrust may not effectively open the airway and it may cause spinal movement. Opening the airway is a priority when a trauma victim is unresponsive. Healthcare providers treating a victim with suspected cervical spine injury should attempt to open the airway with the jaw thrust, but if the healthcare provider cannot open the airway with the jaw thrust, the provider should use the head tilt–chin lift.

Manual stabilization is preferred to application of immobilization devices during CPR for the victim with head and neck trauma because immobilization devices may interfere with effective CPR. If a second rescuer is present, that rescuer should manually stabilize the head and neck during CPR.

Check for “Adequate” Breathing in Adults and Presence or Absence of Breathing in Infant and Child

2005 (New): The BLS healthcare provider checks for *adequate* breathing (lay rescuers check for “normal” breathing) in adult victims. If adequate breathing is not present, the rescuer should give 2 rescue breaths. The BLS healthcare provider checks for presence or absence of breathing in the infant or child and gives 2 breaths if the infant or child is not breathing.

Advanced healthcare providers (with ACLS and PALS training) will assess for adequate breathing in victims of all ages (including infants and children) and should be prepared to support oxygenation and ventilation.

2000 (Old): The healthcare provider checked for adequate breathing for victims of all ages.

CPR PRIORITIES FOR THE HEALTHCARE PROVIDER

CALL FIRST (activate the emergency response system) *except* if you are a lone rescuer with a victim of likely asphyxial cardiac arrest. Such victims will include all infants and children who do not have a sudden, witnessed collapse.

Use an AED as soon as it is available *except* if you are in the out-of-hospital setting with

- an unresponsive child who did not have a sudden witnessed arrest. With such children you should perform 5 cycles (or 2 minutes) of CPR prior to using an AED.
- an adult with unwitnessed arrest (the adult is already unresponsive when you arrive) and you are an EMS responder with a call-to-arrival interval greater than 4 to 5 minutes. Then you may perform 5 cycles or about 2 minutes of CPR before using the AED.

Why: In general, BLS healthcare providers should be prepared to administer rescue breaths if the victim is not breathing adequately. Healthcare providers should not wait to give rescue breaths until adult respiratory arrest occurs. Children may demonstrate breathing patterns, such as rapid breathing or grunting, which are adequate but not normal. The pediatric science experts feel that assessment of “adequate” breathing in an infant or child is a challenging skill that is more consistent with advanced provider skills (ie, PALS).

Attempt to Give 2 Effective Breaths for Infant, Child

2005 (New): Healthcare providers should try “a couple of times” to deliver 2 effective breaths (breaths that cause visible chest rise) to the infant or child.

2000 (Old): Healthcare providers were told to move the child’s head through a variety of positions to obtain optimal airway opening and effective rescue breaths.

Why: The most common mechanism of cardiac arrest in infants and children is asphyxial, so the infant or child in cardiac arrest is likely to be hypoxic and hypercarbic. Rescuers must be able to provide effective rescue breaths (ie, breaths that cause visible chest rise). The healthcare provider is not expected to try indefinitely but should try “a couple of times” if needed to deliver effective breaths.

Rescue Breathing Without Chest Compressions

2005 (New): If the unresponsive victim is not breathing but has a pulse, the healthcare provider will give rescue breathing without chest compressions. The provider will deliver 10 to 12 breaths per minute for an adult (approximately 1 breath every 5 or 6 seconds) and 12 to 20 breaths per minute for an infant or child (approximately 1 breath every 3 to 5 seconds).

2000 (Old): Healthcare providers delivered 10 to 12 breaths per minute for the adult and 20 breaths per minute for the infant or child.

Why: The wider range of acceptable breaths for the infant and child will allow the provider to tailor support to the patient.

Healthcare providers may assist lay rescuers in providing CPR in the community. Healthcare providers should be aware that

lay rescuers are not taught to check for signs of circulation or a pulse. Consequently lay rescuers are not taught to deliver rescue breathing without chest compressions.

Rescue Breaths With Chest Compressions

2005 (New): All rescuers should deliver each rescue breath during CPR (via mouth to mouth, mouth to shield, mouth to mask, or bag mask, or via advanced airway, with or without supplementary oxygen) over 1 second (Class IIa). The volume of each rescue breath should be sufficient to produce *visible chest rise* (Class IIa). Rescuers should avoid delivering more breaths than are recommended or breaths that are too large or too forceful.

It is impossible to estimate the tidal volume delivered during rescue breaths, although an adult ventilating bag (volume of 1 to 2 L) is required to deliver sufficient volume to produce visible chest rise in an adult. The rescuer will need to compress a 1-L bag about halfway and a 2-L bag by about one third when delivering rescue breaths to an adult victim, but the volume delivered should produce visible chest rise. The 2005 guidelines recommend that manikins be configured so that visible chest rise occurs at a tidal volume of about 500 to 600 mL.

2000 (Old): Various tidal volumes were recommended and rescuers were taught to deliver them over 1 to 2 seconds. The recommended tidal volume for rescue breaths for adults was approximately 700 to 1000 mL.

Why: Less ventilation than normal is needed during CPR. The 2005 AHA guidelines note the following regarding delivery of rescue breaths:

- *Oxygen delivery* is the product of oxygen content in arterial blood and cardiac output (blood flow). During the first minutes of CPR for VF SCA, the oxygen content in the blood initially remains adequate; oxygen delivery to vital organs is limited by reduced blood flow (cardiac output). Therefore, immediately after VF SCA, rescue breaths (that can help increase oxygen content in the blood) are not as important as effective chest compressions that create blood flow. The rescuer must provide effective chest compressions to optimize blood flow and, as a result, oxygen delivery to vital organs including the brain and heart.

- The relationship between ventilation (volume of breaths \times rate) and the blood flow to the lungs is called the ventilation-perfusion ratio (V/Q). For the best oxygenation of the blood and elimination of carbon dioxide, ventilation should closely match perfusion. During CPR, blood flow to the lungs is only about 25% to 33% of normal, so less ventilation (fewer breaths and smaller volume) is needed to provide oxygen and eliminate carbon dioxide during cardiac arrest than when the victim has a perfusing rhythm with normal or near-normal cardiac output and normal blood flow to the lungs.
- Hyperventilation (too many breaths or too large a volume) during CPR is not necessary and can be harmful for several reasons. The positive pressure in the chest that is created by rescue breaths will decrease venous return to the heart. This limits the refilling of the heart, so it will reduce cardiac output created by subsequent chest compressions. Large tidal volumes and forceful breaths in the unprotected airway are also likely to cause gastric inflation and its complications.

When providing rescue breaths, rescuers should deliver breaths over 1 second, with a volume sufficient to produce visible chest rise. For additional information, see “CPR With an Advanced Airway,” below.

Chest Compressions Recommended for Symptomatic Bradycardia in Infant or Child

2005 (New): If despite adequate oxygenation and ventilation (or delivery of the 2 rescue breaths to the unresponsive victim) the heart rate of the infant or child is <60 bpm with signs of poor systemic perfusion, the healthcare provider should begin chest compressions.

2000 (Old): This same recommendation was contained in the 2000 guidelines; however, it was not incorporated into BLS training.

Why: Bradycardia is a common terminal rhythm observed in infants and children. The healthcare provider should not wait for the development of pulseless arrest to begin chest compressions for the infant or child with poor perfusion who does not improve with support of oxygenation and ventilation.

Emphasis on Chest Compression Depth and Rate, Chest Wall Recoil, and Minimal Interruptions

2005 (New): Effective chest compressions are essential to provide blood flow during CPR (Class I). The 2005 guidelines emphasize that the rescuer should “push hard, push fast, and allow the chest to recoil after each compression.”

The most effective chest compressions are produced if rescuers push hard, push fast at a rate of 100 per minute (Class IIa), allow full chest recoil after each compression (Class IIb), and minimize interruptions of compressions.

Healthcare providers should interrupt chest compressions as infrequently as possible and should limit interruptions to no more than 10 seconds at a time except for specific interventions such as insertion of an advanced airway or use of a defibrillator (Class IIa). Interruptions for rescue breaths or pulse checks should take less than 10 seconds.

2000 (Old): The recommendations for depth and rate of chest compressions were the same. Less emphasis was given to the need for adequate depth of compression, complete recoil of the chest, and minimizing interruptions in chest compressions.

Why: To be effective, chest compressions must provide adequate blood flow to the heart (coronary artery blood flow) and the brain (cerebral blood flow). Effective blood flow is related to the rate and depth of compressions. Yet studies of CPR performed by healthcare providers showed that half of the chest compressions provided were too shallow, and no compressions were provided during 24% to 49% of CPR time.

Allowing complete chest recoil after each compression allows blood to return to the heart to refill the heart. If the chest is not allowed to recoil/reexpand, there will be less venous return to the heart, and filling of the heart is reduced. As a result, cardiac output produced by subsequent chest compressions will be reduced.

When chest compressions are interrupted, blood flow stops and coronary artery perfusion pressure quickly falls. The lower the coronary artery perfusion pressure, the lower the victim’s chance of survival. When rescuers are giving cycles of compressions and rescue breaths, they should deliver the

breaths as efficiently as possible (ie, deliver the 2 breaths over less than 10 seconds) to minimize interruptions in chest compressions.

Rescuers Should Change Compressors Every 2 Minutes

2005 (New): When more than 1 rescuer is present, rescuers should change “compressor” roles about every 2 minutes or 5 cycles of CPR (1 cycle of CPR = 30 compressions and 2 rescue breaths). Rescuers should try to complete the switch in 5 seconds or less (Class IIb). For information about 2-rescuer CPR when an advanced airway is in place, see “CPR With an Advanced Airway,” below.

2000 (Old): When the first rescuer performing chest compressions becomes fatigued, the rescuers should change positions with minimal interruptions in chest compressions.

Why: In manikin studies, rescuer fatigue, as demonstrated by inadequate chest compression rate or depth and inadequate chest recoil, developed in as little as 1 to 2 minutes. However, rescuers did not report feeling fatigued for 5 minutes or longer. In studies of actual resuscitations by professional rescuers, 50% of chest compressions were not deep enough. Given the importance of effective chest compressions, it will be helpful for rescuers to alternate compressor responsibilities.

Rescuers Can Use 1 or 2 Hands for Chest Compressions at Nipple Line for Child

2005 (New): For chest compressions on children, rescuers should use the heel of 1 or 2 hands to compress the lower half of the sternum to a depth of one third to one half the chest diameter. If 2 hands are used, hand placement is the same as that used for compression of adult victims (the depth of compression will be different). Rescuers should compress at about the nipple line.

2000 (Old): In children (>approximately 1 year), compress the chest with the heel of 1 hand.

Why: Children as well as rescuers come in all sizes. Rescuers should use the technique that will enable them to give effective chest compressions. One child manikin study showed that some rescuers performed better chest compressions using the “adult” technique of 2-hand placement and compressions.

Refinement of Instructions for Chest Compressions in Infants During 2-Rescuer CPR

2005 (New): Healthcare providers should use the 2 thumb–encircling hands technique for 2-rescuer CPR for infants. With this technique the healthcare provider forcefully compresses the sternum with the thumbs while using the fingers to squeeze the thorax (Class IIa).

2000 (Old): The 2 thumb–encircling hands technique was the preferred technique for 2-rescuer healthcare provider CPR for infants. Simultaneous compression of the chest wall with the fingers was not described.

Why: There is additional evidence that the 2 thumb–encircling hands technique produces higher coronary artery perfusion pressure. It also more consistently results in appropriate depth or force of compression, and it may generate higher systolic and diastolic blood pressures. As with adult chest compression, allow the chest to fully reexpand after each compression to allow adequate venous return to the heart and adequate refilling of the heart.

Compression-to-Ventilation Ratios for Infants and Children

2005 (New): Lone healthcare providers should use a compression-to-ventilation ratio of 30:2 for infants, children, and adults (Class Indeterminate for infants and children, Class IIa for adults). Rescuers performing 2-rescuer CPR (eg, all healthcare providers and those completing a healthcare provider course, such as lifeguards) should use a 15:2 ratio for infants and for children (aged 1 year until the onset of puberty). For information about CPR with an advanced airway in place, see below.

2000 (Old): A compression-to-ventilation ratio of 15:2 for adults and a compression-to-ventilation ratio of 5:1 for infants and children were recommended.

Why: This change was made to simplify lay rescuer training and to reduce interruptions in chest compressions by all rescuers. Healthcare providers should be able to recall and use a different compression-to-ventilation ratio for 1-rescuer and 2-rescuer CPR for infants and children. The 15:2 compression-to-ventilation ratio for 2-rescuer CPR for infants and children will provide the additional ventilations they are

TABLE 2. Summary of BLS ABCD Maneuvers for Infants, Children, and Adults (Newborn/Neonatal Information Not Included) *Note:* Maneuvers used only by healthcare providers are indicated by “HCP.”

MANEUVER	ADULT	CHILD	INFANT
	Lay rescuer: ≥8 years HCP: Adolescent and older	Lay rescuers: 1 to 8 years HCP: 1 year to adolescent	Under 1 year of age
ACTIVATE Emergency Response Number (lone rescuer)	Activate when victim found unresponsive HCP: if asphyxial arrest likely, call after 5 cycles (2 minutes) of CPR	Activate after performing 5 cycles of CPR For sudden, witnessed collapse, activate after verifying that victim unresponsive	
AIRWAY	Head tilt–chin lift (HCP: suspected trauma, use jaw thrust)		
BREATHS Initial	2 breaths at 1 second/breath	2 effective breaths at 1 second/breath	
HCP: Rescue breathing without chest compressions	10 to 12 breaths/min (approximately 1 breath every 5 to 6 seconds)	12 to 20 breaths/min (approximately 1 breath every 3 to 5 seconds)	
HCP: Rescue breaths for CPR with advanced airway	8 to 10 breaths/min (approximately 1 breath every 6 to 8 seconds)		
Foreign-body airway obstruction	Abdominal thrusts		Back slaps and chest thrusts
CIRCULATION HCP: Pulse check (≤10 sec)	Carotid (HCP can use femoral in child)		Brachial or femoral
Compression landmarks	Center of chest, between nipples		Just below nipple line
Compression method Push hard and fast Allow complete recoil	2 Hands: Heel of 1 hand, other hand on top	2 Hands: Heel of 1 hand with second on top or 1 Hand: Heel of 1 hand only	1 rescuer: 2 fingers HCP: 2 rescuers: 2 thumb–encircling hands
Compression depth	1½ to 2 inches	Approximately ⅓ to ½ the depth of the chest	
Compression rate	Approximately 100/min		
Compression-ventilation ratio	30:2 (1 or 2 rescuers)	30:2 (single rescuer) HCP: 15:2 (2 rescuers)	
DEFIBRILLATION			
AED	Use adult pads. Do not use child pads/child system. HCP: For out-of-hospital response may provide 5 cycles/2 minutes of CPR before shock if response > 4 to 5 minutes and arrest not witnessed.	HCP: Use AED as soon as available for sudden collapse and in-hospital. All: After 5 cycles of CPR (out-of-hospital). Use child pads/child system for child 1 to 8 years if available. If child pads/system not available, use adult AED and pads.	No recommendation for infants <1 year of age

likely to need. Healthcare providers should minimize interruption of chest compressions to deliver rescue breaths.

2-Rescuer CPR With an Advanced Airway

2005 (New): Healthcare providers should deliver cycles of compressions and ventilations during CPR when there is no advanced airway (eg, endotracheal tube,

LMA, or Combitube) in place. Once an advanced airway is in place for infant, child, or adult victims, 2 rescuers no longer deliver cycles of compressions interrupted with pauses for ventilation. Instead, the compressing rescuer should deliver 100 compressions per minute continuously, without pauses for ventilation. The rescuer delivering the rescue breaths (ventilations) should give 8 to 10 breaths per minute for infant, child, or adult victims and should

be careful to avoid delivering an excessive number of ventilations. A ventilation rate of about 8 to 10 breaths per minute will be the equivalent of giving 1 breath about every 6 to 8 seconds.

2000 (Old): Former guidelines recommended “asynchronous” compressions and ventilations (compressions and ventilations not timed with one another) during CPR when an advanced airway is in place. A ventilation rate of 12 to 15 per minute was recommended for adults during CPR with an advanced airway. Rescuers were taught to recheck for signs of circulation “every few minutes.” The recommendations to avoid overventilation focused on prevention of gastric inflation.

Why: Once an advanced airway is in place, ventilation can be accomplished during compressions, so rescuers no longer need to pause chest compressions to allow delivery of ventilation. This allows the compressing rescuer to provide uninterrupted chest compressions.

Once an advanced airway is in place, rescuers should be particularly careful to avoid delivery of an excessive number of breaths. Several studies of actual CPR by healthcare providers showed that many victims receive too many breaths, breaths with too large a volume, or both. Rescuers should practice delivering the correct number of breaths during CPR.

During CPR a lower than normal respiratory rate will maintain adequate oxygenation and carbon dioxide elimination because blood flow to the lungs is much lower than normal. Rescuers should avoid overventilation because it increases intrathoracic pressure, interferes with venous return of blood to the heart (so it prevents adequate refilling of the heart), and therefore decreases the cardiac output generated by subsequent chest compressions.

Streamlining Actions for Relief of Foreign-Body Airway Obstruction

2005 (New): Terms used to distinguish choking victims who require intervention (eg, abdominal thrusts or back slaps and chest thrusts) from those who do not have been simplified to refer only to signs of *mild* versus *severe* airway obstruction. Rescuers should act if they observe signs of *severe* airway obstruction: poor air exchange and increased breathing difficulty, a silent cough,

cyanosis, or inability to speak or breathe. Rescuers should ask 1 question: “Are you choking?” If the victim nods yes, help is needed.

If the victim becomes *unresponsive*, all rescuers are instructed to activate the emergency response number at the appropriate time and provide CPR. There is one change from 2000: every time the rescuer opens the airway (with a head tilt–chin lift) to deliver rescue breaths, the rescuer should look in the mouth and remove an object if one is seen. The tongue–jaw lift is no longer taught, and blind finger sweeps should not be performed.

2000 (Old): Rescuers were taught to recognize partial airway obstruction with good air exchange, partial airway obstruction with poor air exchange, and complete airway obstruction. Rescuers were taught to ask the victim 2 questions: “Are you choking?” (the victim who needs help must nod yes) and “Can you speak?” (the victim with obstructed airway must shake his or her head no).

In treating the unresponsive victim with FBAO, the healthcare provider was taught a complicated sequence that included abdominal thrusts.

Why: The goal of these revisions is simplification. Experts could find no evidence that a complicated series of maneuvers is any more effective than simple CPR. Some studies showed that chest compressions performed during CPR increased intrathoracic pressure as high as or higher than abdominal thrusts. Blind finger sweeps may result in injury to the victim’s mouth and throat or to the rescuer’s finger with no evidence of effectiveness.

Defibrillation

The changes recommended in the 2005 guidelines are designed to minimize interruptions in chest compressions. In addition, they acknowledge the high first-shock success of biphasic waveforms in eliminating VF or rapid ventricular tachycardia (VT).

Major changes in defibrillation:

- Immediate defibrillation is appropriate for all rescuers responding to sudden witnessed collapse with an AED on site (for victims ≥ 1 year of age). Compression before defibrillation may be considered when

EMS arrival at the scene of sudden collapse is >4 to 5 minutes after the call.

- One shock followed by immediate CPR, beginning with chest compressions, is used for attempted defibrillation. The rhythm is checked after 5 cycles of CPR or 2 minutes.
- For attempted defibrillation of an adult, the dose using a monophasic manual defibrillator is 360 J.
- The ideal defibrillation dose using a biphasic defibrillator is the dose at which the device waveform has been shown to be effective in terminating VF. The initial selected dose for attempted defibrillation using a biphasic manual defibrillator is 150 J to 200 J for a biphasic truncated exponential waveform or 120 J for a rectilinear biphasic waveform. The second dose should be the same or higher. If the rescuer does not know the type of biphasic waveform in use, a default dose of 200 J is acceptable.
- Reaffirmation of 2003 ILCOR statement that AEDs may be used in children 1 to 8 years of age (and older). For children 1 to 8 years of age, rescuers should use an AED with a pediatric dose-attenuator system if one is available.
- Elements of successful community lay rescuer AED programs were revised.
- Instructions for shocking VT were clarified.

What did NOT change:

- The initial dose for attempted defibrillation for infants and children using a monophasic or biphasic manual defibrillator. First dose 2 J/kg; second and subsequent doses 4 J/kg.
- The dose for synchronized cardioversion for infants and children
- The dose for synchronized cardioversion for supraventricular arrhythmias and for stable, monomorphic VT in adults

Compression First Versus Shock First for VF Sudden Cardiac Arrest

2005 (New): When any rescuer witnesses an *adult* cardiac arrest and an AED is immediately available on site, the rescuer should use the AED as soon as possible. This recommendation applies to lay rescuers as well as to healthcare providers who are working in hospitals or other facilities with AEDs on site. When more than 1 rescuer

is available, 1 rescuer should provide CPR until the AED arrives. Ideally 1 rescuer should continue CPR until another rescuer turns the AED on and attaches the AED electrode pads and the device is ready to analyze the victim’s heart rhythm.

When any healthcare provider witnesses a *child* collapse *suddenly*, the provider should phone (or send someone to phone) the emergency response number and should begin CPR and should attach an AED and use it as soon as possible. When using an AED for an unresponsive child who did not have witnessed collapse, a rescuer should give 5 cycles or about 2 minutes of CPR before using an AED.

When EMS personnel arrive at the scene of an out-of-hospital cardiac arrest that they have not witnessed, it is reasonable for them to give about 5 cycles (about 2 minutes) of CPR before checking the ECG rhythm and attempting defibrillation (Class IIb). In systems with a typical EMS call-to-response interval >4 to 5 minutes, EMS physician directors may consider implementing a protocol that would allow EMS responders to provide about 5 cycles or 2 minutes of CPR before attempted defibrillation for victims with a history of sudden collapse (Class IIb).

2000 (Old): The AHA recommended the use of an AED as soon as it was available for all adult victims of SCA. When use of AEDs for children 1 to 8 years was recommended in 2003, the AHA recommended the use of an AED after 1 minute of CPR.

Why: Two of three studies showed that 1½ to 3 minutes of EMS CPR before attempted defibrillation improved survival for victims of VF SCA *if the EMS providers arrived at the scene 4 to 5 minutes or longer after the EMS call*. There was no difference in survival (CPR first or shock first) for victims when the EMS responders arrived at the victim’s side in less than 4 to 5 minutes from call. Note that one randomized study did not show any difference in outcome whether CPR was provided before attempted defibrillation or not.

When VF cardiac arrest is present for several minutes, the heart has probably used up most of the available oxygen and substrate needed to contract (pump) effectively. At this point the amplitude (size) of the VF waveform is typically low, and shock delivery may not eliminate VF. Even if a shock does eliminate VF, when the heart has been without oxygen

for several minutes before shock delivery, it is unlikely to pump blood effectively for the first several seconds or minutes after defibrillation. A period of CPR *before* shock delivery will provide some blood flow to the heart, delivering some oxygen and substrate to the heart muscle. This will make a shock more likely to eliminate VF and will make the heart more likely to resume an effective rhythm and effective pumping function after shock delivery.

1 Shock Plus Immediate CPR for Attempted Defibrillation

2005 (New): To treat cardiac arrest associated with VF or pulseless VT, the 2005 guidelines recommend delivery of single shocks followed immediately by a period of CPR, beginning with chest compressions (Class IIa). Rescuers should not interrupt chest compressions to check circulation (eg, evaluate rhythm or pulse) until about 5 cycles or approximately 2 minutes of CPR have been provided after the shock. These recommendations may be modified for the in-hospital setting, particularly where continuous electrocardiographic or hemodynamic monitoring may be in place.

2000 (Old): The use of a “stacked” sequence of up to 3 shocks was recommended, without interposed chest compressions, for the treatment of VF/pulseless VT.

Why: The 3-shock recommendations were based on the use of monophasic defibrillator waveforms. Repeated shocks were necessary with monophasic waveforms because the first shock was often unsuccessful, and several shocks were typically needed to eliminate VF. Three shocks in rapid succession were more likely to be effective than single shocks because transthoracic impedance decreased and current delivery to the heart increased with each shock delivered.

Modern biphasic defibrillators have a much higher (85% to 94%) first-shock success rate than monophasic defibrillators, so VF is likely to be eliminated with 1 biphasic waveform shock. In 2005 the rhythm analysis for a 3-shock sequence performed by commercially available AEDs resulted in delays of 19 to 37 seconds or longer between delivery of the first shock and delivery of the first post-shock compression. This long hands-off time cannot be justified when VF is unlikely to be present and victims are likely to need CPR.

If 1 shock fails to eliminate VF, the VF may be of low amplitude (indicative of a myocardium depleted of oxygen and substrates). In such patients immediate CPR, particularly with effective chest compressions, is likely to provide blood flow to the myocardium and improve the likely success of a shock. In fact, even when shock delivery is successful in eliminating VF, most victims demonstrate a nonperfusing rhythm (pulseless electrical activity [PEA] or asystole) for the first minutes after defibrillation. These victims need immediate CPR, especially chest compressions. No evidence indicates that chest compressions immediately after defibrillation will provoke recurrent VF.

Monophasic Waveform Defibrillation Dose for Adults

2005 (New): The recommended dose for initial and subsequent shocks using monophasic waveform for treatment of VF/pulseless VT in adults is 360 J. For manual defibrillation doses in infants and children, see “Pediatric Advanced Life Support,” below.

2000 (Old): The recommended dose for an initial shock using a monophasic waveform for treatment of VF/pulseless VT in adults was 200 J. The second recommended dose was 200 to 300 J, and the recommended dose for the third and subsequent shocks was 360 J.

Why: The goal of changing the monophasic shock dose to a single dose is to simplify training and reduce the number of different doses that providers need to learn, remember, and use. This recommendation is not intended to require reprogramming of AEDs that currently deliver the doses recommended in 2000. Because few monophasic AEDs are still being produced, the issue of monophasic dosing will become less relevant over time.

Manual Biphasic Waveform Defibrillation Dose for Adults

2005 (New): The initial selected shock dose for adults is 150 J to 200 J for a biphasic truncated exponential waveform or 120 J for a rectilinear biphasic waveform. The second dose should be the same or higher (Class IIa). Nonescalating or escalating energy biphasic waveform shocks can be used safely and effectively to terminate short-duration and long-duration VF (Class IIa).

Rescuers should use the device-specific defibrillation dose, ie, the dose at which the biphasic device they are using has proved effective in eliminating VF. The manufacturers should note this dose on the front of the defibrillator. If the rescuer is unfamiliar with the device-specific dose, the consensus recommendation is to use a default dose of 200 J.

For manual defibrillation doses in infants and children, see “Pediatric Advanced Life Support,” below.

2000 (Old): In 2000 the recommended dose for an initial shock using a monophasic waveform for treatment of VF/pulseless VT in adults was 200 J. The second recommended dose was 200 to 300 J, and the recommended dose for the third and subsequent shocks was 360 J. The biphasic dose recommended was one shown to be equivalent to monophasic waveforms.

Why: The goal of this recommendation is to simplify attempted defibrillation and to support the use of device-specific doses of proven effectiveness. Rescuers should note that with the rectilinear biphasic waveform, energies selected by the operator will typically differ from delivered energies. Data is insufficient to support superiority of either escalating energy or nonescalating energy dosing. Providers should be familiar with the defibrillators they use clinically.

Use of AEDs in Children

2005 (New): As noted above in the Major Changes section, since 2003 the use of AEDs is recommended for children in cardiac arrest 1 year of age and older. For sudden, witnessed arrest in the child or adult in the out-of-hospital setting, the lone healthcare provider should phone the emergency response number, retrieve the AED, and return to the victim to perform CPR and use the AED. AEDs should be used as soon as they are available for in-hospital resuscitation.

Lay rescuers and healthcare providers responding to an unwitnessed or nonsudden cardiac arrest in the child in the out-of-hospital setting should use the AED after giving 5 cycles or about 2 minutes of CPR. Evidence is insufficient to recommend for or against use of AEDs in infants less than 1 year of age (Class Indeterminate).

2000 (Old): Use of AEDs in children 8 years of age and older was recommended (Class IIb). Evidence was insufficient to recommend for or against AED use in children under 8 years old (Class Indeterminate). AEDs could be used to identify the rhythm of children 1 to 8 years of age (Class IIb). In 2003 AHA and ILCOR published a statement noting that AEDs could be used in children 1 to 8 years old.

Why: Evidence published since 2000 has established the safety of biphasic waveforms and the ability of most AEDs to recognize shockable rhythms in infants and children. If an AED system is available that reduces (attenuates) the delivered energy dose through use of a special pad/cable system or other method, that system should be used for children 1 to 8 years old but not for children 8 years of age or older or for adults.

Community Lay Rescuer AED Programs

2005 (New): CPR and AED use by public safety first responders are recommended to increase survival rates for SCA (Class I). AED programs in public locations where there is a relatively high likelihood of witnessed cardiac arrest (eg, airports, casinos, sports facilities) are recommended (Class I). Common elements of successful community lay rescuer AED programs are:

- A planned and practiced response, typically requiring oversight by a healthcare provider
- Training and equipping of rescuers in CPR and use of the AED
- A link with the local EMS system
- A program of device maintenance and ongoing quality improvement

There is insufficient evidence to recommend for or against the deployment of AEDs in homes (Class Indeterminate).

2000 (Old): The key elements of successful AED programs included physician prescription and oversight, training of likely rescuers, link with the local EMS system, and a process of continuous quality improvement.

Why: High survival rates from out-of-hospital SCA have been reported in some settings, particularly in community programs that provide early recognition, early CPR, and early defibrillation. The North American Public Access Defibrillation

trial showed that organized community lay rescuer CPR and AED programs improved survival to hospital discharge for victims with witnessed VF SCA. In addition, survival rates from witnessed VF SCA as high as 49% to 74% have been reported by lay rescuer CPR and AED programs in airports and casinos and with police officers. The North American trial results reinforced the importance of a planned and practiced response. Even at sites with AEDs in place the AEDs were deployed for fewer than half of the cardiac arrests at those sites, indicating the need for frequent CPR. Some AEDs do not require a prescription, so healthcare provider oversight is not mandatory for lay rescuer AED programs.

Clarification for Shock Delivery for Ventricular Tachycardia

2005 (New): If a patient has polymorphic VT, the patient is likely to be unstable, and rescuers should treat the rhythm as VF. They should deliver high-energy *unsynchronized* shocks (ie, defibrillation doses). If there is any doubt whether monomorphic or polymorphic VT is present in the *unstable* patient, do not delay shock delivery to perform detailed rhythm analysis—provide high-energy unsynchronized shocks (ie, defibrillation doses). Rescuers should use the ACLS Pulseless Arrest Algorithm.

2000 (Old): Synchronized cardioversion was recommended for stable polymorphic VT.

Why: Although synchronized cardioversion is preferred for treatment of an organized ventricular rhythm, for some irregular rhythms, such as polymorphic VT, synchronization is not possible. Lower energy levels should not be used for these unsynchronized shocks because low-energy shocks have a high likelihood of provoking VF when given in an unsynchronized mode.

Advanced Cardiovascular Life Support (ACLS)

Effective ACLS begins with high-quality BLS, particularly high-quality CPR. Changes in the ACLS treatment of cardiac arrest have been designed to minimize interruptions in chest compressions for rhythm check, pulse check, and ACLS therapies. To minimize interruptions in chest compressions, the resuscitation team leader should plan interventions such as rhythm checks, insertion of an airway, and even drug

administration around uninterrupted periods of CPR.

The potential effects of any drugs or ACLS therapy on outcome from VF SCA arrest are dwarfed by the potential effects of immediate, high-quality CPR and early defibrillation. There is much less emphasis on drug therapy during cardiac arrest and much more emphasis on CPR with minimal interruptions in chest compressions.

Major changes in ACLS include

- Emphasis on high-quality CPR. See information in the BLS for Healthcare Providers section, particularly rescue breaths with chest compressions and emphasis on chest compression depth and rate, chest wall recoil, and minimal interruptions.
- Increased information about use of LMA and esophageal-tracheal combitube (Combitube). Use of endotracheal intubation is limited to providers with adequate training and opportunities to practice or perform intubations.
- Confirmation of endotracheal tube placement requires both clinical assessment and use of a device (eg, exhaled CO₂ detector, esophageal detector device). Use of a device is part of (primary) confirmation and is not considered secondary confirmation.
- The algorithm for treatment of pulseless arrest was reorganized to include VF/pulseless VT, asystole, and PEA.
 - ✦ The priority skills and interventions during cardiac arrest are BLS skills, including effective chest compressions with minimal interruptions.
 - ✦ Insertion of an advanced airway may not be a high priority.
 - ✦ If an advanced airway is inserted, rescuers should no longer deliver cycles of CPR. Chest compressions should be delivered continuously (100 per minute) and rescue breaths delivered at a rate of 8 to 10 breaths per minute (1 breath every 6 to 8 seconds).
 - ✦ Providers must organize care to minimize interruptions in chest compressions for rhythm check, shock delivery, advanced airway insertion, or vascular access.

- Intravenous or intraosseous (IO) drug administration is preferred to endotracheal administration.
- Treatment of VF/pulseless VT:
 - ✦ To attempt defibrillation, 1 shock is delivered (see “Defibrillation” for defibrillation doses using monophasic or biphasic waveforms) followed immediately by CPR (beginning with chest compressions).
 - ✦ Rescuers should minimize interruptions in chest compressions and particularly minimize the time between compression and shock delivery, and shock delivery and resumption of compressions.
 - ✦ Compressions should ideally be interrupted only for rhythm checks and shock delivery. Rescuers should provide compressions (if possible) after the rhythm check, while the defibrillator is charging. Then compressions should be briefly interrupted when it is necessary to “clear” the patient and deliver the shock, but the chest compressions should resume immediately after the shock delivery.
 - ✦ Providers do not attempt to palpate a pulse or check the rhythm after shock delivery. If an organized rhythm is apparent during rhythm check after 5 cycles (about 2 minutes) of CPR, the provider checks a pulse.
 - ✦ Drugs should be delivered during CPR, as soon as possible after rhythm checks.
 - If a third rescuer is available, that rescuer should prepare drug doses before they are needed.
 - If a rhythm check shows persistent VF/VT, the appropriate vasopressor or antiarrhythmic should be administered as soon as possible after the rhythm check. It can be administered during the CPR that precedes (until the defibrillator is charged) or follows the shock delivery.
 - The timing of drug delivery is less important than is the need to minimize interruptions in chest compressions.
 - ✦ Vasopressors are administered when an IV/IO line is in place, typically if VF or pulseless VT persists after the first or second shock. Epinephrine may be given

every 3 to 5 minutes. A single dose of vasopressin may be given to replace either the first or second dose of epinephrine.

- ✦ Antiarrhythmics may be considered after the first dose of vasopressors (typically if VF or pulseless VT persists after the second or third shock). Amiodarone is preferred to lidocaine, but either is acceptable.
- Treatment of asystole/pulseless electrical activity: epinephrine may be administered every 3 to 5 minutes. One dose of vasopressin may replace either the first or the second dose of epinephrine.
- Treatment of symptomatic bradycardia: the recommended atropine dose is now 0.5 mg IV, may repeat to a total of 3 mg. Epinephrine or dopamine may be administered while awaiting a pacemaker.
- Treatment of symptomatic tachycardia: a single simplified algorithm includes some but not all drugs that may be administered. The algorithm indicates therapies intended for use in the in-hospital setting with expert consultation available.
- Postresuscitation stabilization requires support of vital organs, with the anticipation of postresuscitation myocardial dysfunction. Some reliable prognostic indicators have been reported.
- Avoid hyperthermia for all patients after resuscitation. Consider inducing hypothermia if the patient is unresponsive but with an adequate blood pressure following resuscitation.

Things that did NOT change in ACLS include the following:

- Most drug doses are the same as those recommended in 2000 (one exception noted above—atropine for bradycardia).
- The need to search for and treat reversible causes of cardiac arrest and failure to respond to resuscitation attempts. These contributing factors are referred to as the H’s (hypovolemia, hypoxia, hydrogen ion, hypo-/hyperkalemia, hypoglycemia, hypothermia) and T’s (toxins, tamponade, tension pneumothorax, thrombosis [includes coronary or pulmonary], trauma [hypovolemia]). These are listed in the ACLS and PALS algorithms.

Use of Advanced Airways

2005 (New): Rescuers must be aware of the risks and benefits of insertion of an advanced airway during a resuscitation attempt. Because insertion of an advanced airway may require interruption of chest compressions for many seconds, the rescuer should weigh the need for compressions against the need for insertion of an advanced airway. Airway insertion may be deferred until several minutes into the attempted resuscitation.

The optimal method of managing the airway during cardiac arrest will vary on the basis of provider experience, EMS or healthcare system characteristics, and patient condition. All healthcare systems must establish processes of continuous quality improvement to monitor and optimize methods of establishing and maintaining an airway.

Studies suggest that the LMA and Combitube can be inserted safely and can provide ventilation that is as effective as bag-mask ventilation (Class IIa).

2000 (Old): The endotracheal tube was considered the ventilation adjunct of choice.

Why: Experience with advanced airways shows clearly that endotracheal intubation by inexperienced providers may be associated with a high complication rate because the tubes may be misplaced or displaced. If advanced airways are used, the providers must evaluate placement and detect misplacement, and the healthcare system must monitor results.

Verify Correct Tube Placement With Clinical Exam and Device

2005 (New): To reduce the risk of unrecognized tube misplacement or displacement, providers should use clinical assessment plus a device such as an exhaled CO₂ detector or an esophageal detector device to evaluate tube location (Class IIa). Providers should confirm the placement of any advanced airway immediately after insertion, in the transport vehicle, and whenever the patient is moved.

Most published studies regarding the use of devices to confirm advanced airway placement have confirmed endotracheal tube placement so there is insufficient evidence to comment on the accuracy of the devices in confirming LMA or Combitube placement.

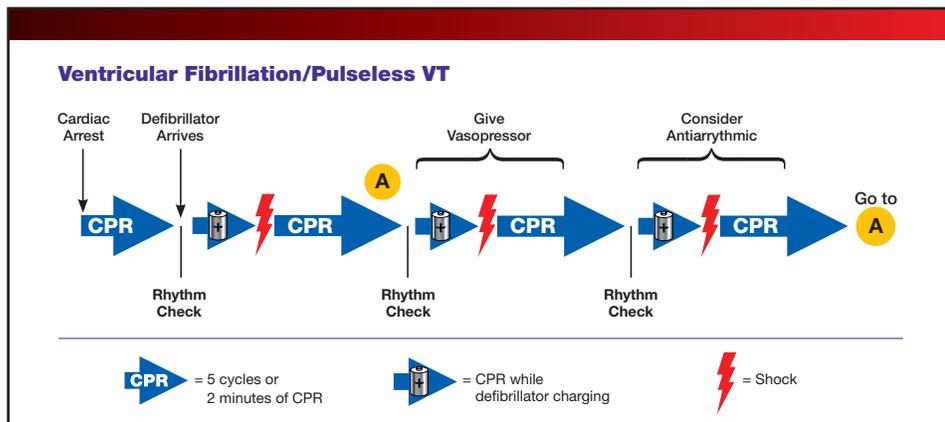


Figure 2: Ventricular Fibrillation and Pulseless VT: Treatment Sequences for ACLS and PALS. This illustrates suggested timing of CPR, rhythm checks, attempted defibrillation (shock delivery), and drug delivery for persistent VF/pulseless VT. Drug doses should be prepared *prior* to rhythm check. Drugs should be administered during CPR, as soon after a rhythm check as possible. Ideally CPR (particularly chest compressions) is interrupted only for rhythm check and shock delivery. If possible, rescuers should perform chest compressions while the defibrillator is charging. Rescuers should resume chest compressions immediately after a shock is delivered. In in-hospital settings with continuous (eg, electrocardiographic, hemodynamic) monitoring in place, this sequence may be modified by the physician. If PEA or asystole develops after a shock (and CPR), rescuers should follow the Asystole/PEA branch of the ACLS or PALS Pulseless Arrest Algorithms.

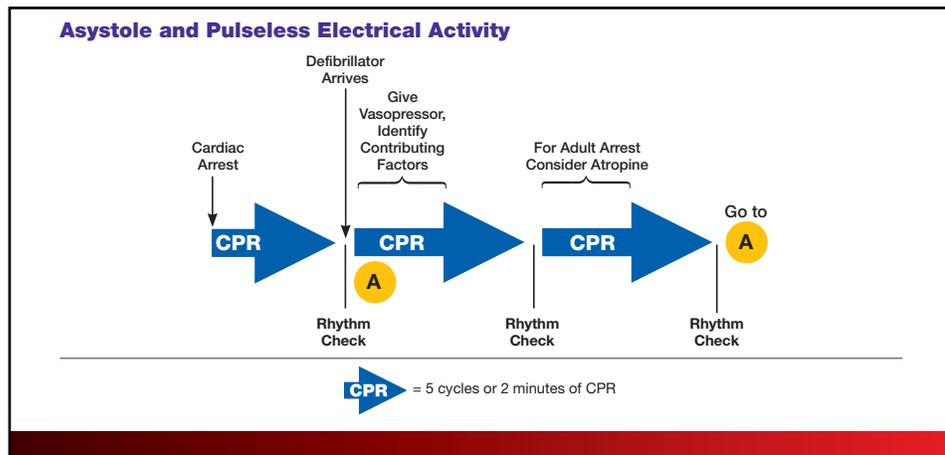


Figure 3: Asystole and Pulseless Electrical Activity: Treatment Sequence for ACLS and PALS. This illustrates the suggested timing of CPR, rhythm checks, and drug delivery for pulseless electrical activity (PEA) or asystole. Drug doses should be prepared *prior* to rhythm check. Drugs should be administered during CPR, as soon after a rhythm check as possible. Rescuers should search for and treat any contributing factors. Ideally CPR (particularly chest compressions) is interrupted only for rhythm check and shock delivery. If possible, rescuers should perform chest compressions while the defibrillator is charging. Rescuers should resume chest compressions immediately after a shock is delivered, without checking the rhythm. In in-hospital settings with continuous (eg, electrocardiographic, hemodynamic) monitoring in place, this sequence may be modified by the physician. If VF/pulseless VT develops, rescuers should follow the VF/Pulseless VT branch of the ACLS or PALS Pulseless Arrest Algorithm.

2000 (Old): Even when the endotracheal tube is seen to pass through the vocal cords and tube position is verified by chest expansion and auscultation during positive-pressure ventilation, rescuers should obtain additional confirmation of placement using an end-tidal CO₂ or esophageal detection device (Class IIa).

Why: The new emphasis is on the need to verify correct tube placement immediately after the tube is inserted, during transport, and whenever the patient is moved. The new wording no longer relegates the use of devices to secondary confirmation but

describes the use of devices as “additional” confirmation needed with clinical assessment.

Priorities of Reorganized ACLS Pulseless Arrest Algorithm

2005 (New): The ACLS Pulseless Arrest Algorithm resembles the PALS Pulseless Arrest Algorithm. Both have a core (“During CPR”) green box that emphasizes high-quality CPR. Therapies are designed around periods (5 cycles or 2 minutes) of uninterrupted CPR. CPR should resume immediately after delivery of 1 shock. Pulse and rhythm are NOT checked after shock

delivery; rhythm checks are performed after 5 cycles (about 2 minutes) of CPR. Rescuers must be organized to limit interruptions in chest compression for interventions such as insertion of an advanced airway or vascular access (Figures 2 and 3).

2000 (Old): Resuscitation for VF/pulseless VT was organized around 1-minute intervals of CPR. As a result, chest compressions were frequently interrupted.

Why: Clinical studies of actual CPR by healthcare providers showed that chest compressions were not performed during 24% to 49% of CPR time. In addition, the high first-shock success rate of biphasic defibrillators means that a single shock is likely to eliminate VF. Most victims, however, have asystole or PEA immediately after shock delivery and require immediate CPR. A major revision in approach is designed to reduce the frequency and length of interruptions in chest compressions. Rather than waste time looking for a “shockable” rhythm or palpating a pulse immediately after shock delivery (neither is likely to be present), rescuers should immediately resume CPR (beginning with chest compressions) and check the rhythm after 5 cycles or 2 minutes of CPR.

Vascular (IV or IO) Preferred to Endotracheal Drug Administration

2005 (New): Although many drugs (including lidocaine, epinephrine, atropine, naloxone, and vasopressin) can be absorbed via the trachea, the IV or IO route of administration is preferred. For this reason, the endotracheal doses of resuscitation medications are not listed in the ACLS Pulseless Arrest Algorithm, although they may be used if no IV/IO access is available.

The optimal endotracheal dose of most drugs is unknown but is typically 2 to 2½ times the recommended IV dose. Providers should dilute the recommended dose in 5 to 10 mL of water or normal saline and inject the drug directly into the endotracheal tube. Studies of epinephrine and lidocaine suggest that dilution in water rather than normal saline may achieve better drug absorption, but there is insufficient evidence to recommend water dilution over normal saline.

2000 (Old): Administration of doses 2 to 2½ times the recommended IV dose was recommended. To administer the drug

by endotracheal route, providers were instructed to pass a catheter beyond the tip of the tracheal tube, stop compressions, inject the drug, follow with several quick insufflations, and resume CPR.

Why: Administration of drugs into the trachea results in lower blood concentration than the same dose given by IV route. Recent animal studies suggest that the lower epinephrine concentrations achieved when the drug is delivered by the endotracheal route may produce transient β -adrenergic effects. These effects can be detrimental, causing hypotension, lower coronary artery perfusion pressure and flow, and reduced potential for return of spontaneous circulation (ROSC). Thus, although endotracheal administration of some resuscitation drugs is possible, IV or IO drug administration is preferred because it provides more predictable drug delivery and pharmacologic effect.

Timing of Drug Administration During Pulseless Arrest

2005 (New): When drug administration is indicated, the drugs should be administered during CPR, as soon as possible after the rhythm is checked. A drug may be administered during the CPR that is performed while the defibrillator is charging, or during the CPR performed immediately after the shock is delivered. Drug delivery should not interrupt CPR. Rescuers should prepare the next drug dose before it is time for the next rhythm check so that the drug can be administered as soon as possible after the rhythm check (Figures 2 and 3). This requires organization and planning.

2000 (Old): Drugs were administered immediately after a post-shock rhythm check, in a “Drug—CPR—shock” (repeat as needed) cycle. CPR was provided for about a minute after drug administration to circulate the drug prior to the next rhythm check. Rhythm checks were performed about every minute during attempted resuscitation, resulting in frequent interruptions in chest compressions.

Why: These revisions were proposed to minimize interruptions in chest compressions during attempted resuscitation. The recommendation to provide immediate CPR for 5 cycles or 2 minutes after an attempted shock required a change in the timing of drug administration.

The consensus recommendation is to administer the drugs as soon as possible after the rhythm check. The guidelines note that the timing of drug delivery is less important than the need to minimize interruptions in chest compressions.

As an alternative, physicians may order drug administration during the CPR interval, but the patient’s rhythm at the time of drug administration will be unknown. The benefit of administering the drugs as soon as possible after the rhythm check is that the drug is then given to treat the rhythm seen at the rhythm check. For example, if VF is present at the first rhythm check after epinephrine was administered, an antiarrhythmic would be the likely drug to administer.

Vasopressors During Cardiac Arrest

2005 (New): Vasopressors are administered when an IV/IO line is in place, typically after the first or second shock. Epinephrine may be given every 3 to 5 minutes. One dose of vasopressin may be given instead of either the first or second dose of epinephrine.

2000 (Old): Epinephrine (Class Indeterminate) or vasopressin (Class IIb) could be given for VF/pulseless VT arrest. For asystole/PEA, epinephrine was recommended, and evidence was insufficient to recommend for or against vasopressin.

Why: Although vasopressin showed promising results, it has not improved rates of intact survival to hospital discharge. As a result a single dose of vasopressin may be used as an alternative to either the first or second dose of epinephrine.

Antiarrhythmics During VF/VT Cardiac Arrest

2005 (New): When VF or pulseless VT persists after 2 to 3 shocks plus CPR and administration of a vasopressor, consider administering an antiarrhythmic such as amiodarone. If amiodarone is unavailable, lidocaine may be considered.

2000 (Old): Consider antiarrhythmics if VF/VT persists after shock delivery and administration of a vasopressor: amiodarone (Class IIb) or lidocaine (Class Indeterminate).

Why: More experience documents the effectiveness of amiodarone and no new evidence has been published documenting the effectiveness of lidocaine.

Treatment of Asystole and Pulseless Electrical Activity

2005 (New): Although epinephrine (1 mg IV/IO) is still recommended and can be given every 3 to 5 minutes for the treatment of asystole or PEA, one dose of vasopressin (40 U IV/IO) may be substituted for either the first or second dose of epinephrine. Atropine (1 mg IV/IO) may still be considered for asystole or slow PEA, up to 3 doses (Figure 4).

2000 (Old): For asystole or PEA, epinephrine was recommended (1 mg every 3 to 5 minutes). Atropine (1 mg IV) could be considered for asystole or slow PEA every 3 to 5 minutes as needed, to a total dose of 0.04 mg/kg.

Why: No placebo-controlled study has demonstrated that vasopressors improve survival from cardiac arrest. Because vasopressors can improve aortic blood pressure and coronary artery perfusion pressure, they continue to be recommended. In general, vasopressin has not been shown to improve survival from cardiac arrest. In one large study, vasopressin (compared with epinephrine) improved survival for a subgroup of patients with asystole, but the patients did not survive neurologically intact. Because the effects of vasopressin have not been shown to differ substantially from those of epinephrine in the treatment of cardiac arrest, both are included in the algorithm. Only 1 dose of vasopressin is administered, replacing either the first or second epinephrine dose.

Treatment of Symptomatic Bradycardia

2005 (New): Prepare for transcutaneous pacing without delay for high-degree block. Consider atropine 0.5 mg IV while awaiting a pacemaker. The atropine may be repeated to a total dose of 3 mg. If the atropine is ineffective, begin pacing. Consider epinephrine infusion (2 to 10 μ g/min) or dopamine infusion (2 to 10 μ g/kg per minute) while awaiting a pacer or if pacing is ineffective. Prepare for transvenous pacing. Treat contributing causes.

2000 (Old): The range of atropine dose for symptomatic bradycardia was 0.5 to 1 mg IV. Consider dopamine (5 to 20 μ g/kg per minute), epinephrine (2 to 10 μ g/min), or isoproterenol (2 to 10 μ g/min).

Why: Studies showed that the effective dose of atropine for symptomatic bradycardia is 0.5 mg IV (repeated as needed to a total dose of 3 mg). Isoproterenol was eliminated from the algorithm because no evidence that was reviewed documented its efficacy.

Treatment of Tachycardia

2005 (New): Treatment of tachycardia is summarized in a single algorithm. Immediate synchronized cardioversion is still recommended for the unstable patient. If the patient is stable, a 12-lead ECG (or a rhythm strip) enables classification of the tachycardia as narrow-complex or wide-complex. These two classifications can be further subdivided into those with regular or irregular rhythms. The algorithm boxes with screened type are designed for in-hospital use or with expert consultation available (others can be used by ACLS providers as appropriate).

2000 (Old): Several tachycardia algorithms divided treatments into those appropriate for patients with adequate ventricular function and those with poor ventricular ejection fraction.

Why: The goal was to simplify therapy and distill the information in the algorithm to the essence of care required for initial stabilization and evaluation in the first hours of therapy. The algorithm is based on the most obvious characteristics of the ECG (QRS width and regularity). It can be used without knowledge of the victim's underlying myocardial function. The use of boxes with screened type signals those areas of the algorithm intended for in-hospital use or with expert consultation.

Postresuscitation Stabilization

2005 (New): Postresuscitation care includes support of myocardial function with anticipation that myocardial "stunning" may be present, requiring vasoactive support. For information about induced hypothermia, see below. It is reasonable for providers to maintain strict glucose control, but additional studies are needed to determine the precise blood glucose concentration that requires insulin therapy and the target range of blood glucose concentration. Clinical signs that correlate strongly with death or poor neurologic outcome include the following:

- Bilateral absence of cortical response to median nerve somatosensory-evoked

potentials measured 72 hours (in the normothermic patient) after hypoxic-ischemic (asphyxial) insult

- Absent corneal reflex at 24 hours
- Absent pupillary response at 24 hours
- Absent withdrawal response to pain at 24 hours
- No motor response at 24 hours
- No motor response at 72 hours

2000 (Old): No specific neurologic signs were noted to be prognostic.

Why: A meta-analysis demonstrated that bilateral absence of cortical response to median nerve somatosensory-evoked potentials predicted poor outcome with 100% specificity when used in normothermic patients who were comatose for at least 72 hours after hypoxic-ischemic (asphyxial) insult. A recent meta-analysis of 11 studies involving 1914 patients documented the 5 clinical signs that strongly predicted death or poor neurologic outcome.

Hypothermia

2005 (New): Unconscious adult patients with ROSC after out-of-hospital cardiac arrest should be cooled to 32°C to 34°C for 12 to 24 hours when the initial rhythm was VF (Class IIa). Similar therapy may be beneficial for patients with non-VF arrest out of hospital or for in-hospital arrest (Class IIb). Further research is needed.

2000 (Old): Mild hypothermia may be beneficial to neurological outcome and is likely to be well tolerated (Class IIb). But hypothermia should not be induced actively after resuscitation from cardiac arrest (Class Indeterminate). In 2003 an interim ILCOR statement supported induced hypothermia.

Why: In 2 randomized clinical trials, induced hypothermia (cooling within minutes to hours after ROSC) resulted in improved survival and neurologic outcome in adults who remained comatose after initial resuscitation from out-of-hospital VF cardiac arrest. Patients in the study were cooled to 33°C or to the range of 32°C to 34°C for 12 to 24 hours. One study, the Hypothermia After Cardiac Arrest (HACA) study, included a small subset of patients with in-hospital cardiac arrest.

Acute Coronary Syndromes

The guidelines for acute coronary syndrome have been updated in light of the 2003-2005 ILCOR evidence evaluation and the recent ACC/AHA Guidelines for Management of ST-elevation Myocardial Infarction (STEMI) and Guidelines for Management of Unstable Angina and Non-STEMI Myocardial Infarction (UA/NSTEMI). See the ACS section of the *2005 AHA Guidelines for CPR and ECC* for more details.

The changes in the ACS guidelines largely comprise refinements and modifications to existing recommendations, including:

- EMS dispatcher may instruct patients with ACS to chew an aspirin (see EMS section).
- The algorithm is streamlined but still focuses on risk stratification using the 12-lead ECG.
- There is more information about identification of high-risk patients with UA/NSTEMI.
- Contraindications to fibrinolytics have been refined to match most recent criteria published by ACC/AHA.

Things that did NOT change:

- Rapid evaluation and risk stratification with the ECG remains time-sensitive.
- Patients with STEMI require rapid reperfusion (with fibrinolytics or percutaneous coronary intervention [PCI]).
- Patients with UA/NSTEMI require risk stratification and may require revascularization by PCI or coronary artery bypass grafting (CABG).
- Adjunctive therapies (aspirin, heparin, clopidogrel, glycoprotein IIb/IIIa inhibitors) are important to improve outcome.

Stroke

The 2005 guidelines reaffirm administration of tissue plasminogen activator (tPA) for carefully selected patients with acute ischemic stroke but caution that tPA must be administered in the setting of a clearly defined protocol and institutional commitment. Stroke units have documented improved outcomes and they are recommended.

Refer to the 2005 guidelines for additional information about stroke care, including a modified table listing contraindications for fibrinolytics and a modified table about management of hypertension. Both are consistent with the most recent management recommended by the American Stroke Association. In addition, the 2005 guidelines recommend lowering of blood glucose in patients with acute ischemic stroke when the serum glucose level is >10 mmol/L ($>$ about 200 mg/dL). This is consistent with studies published from ICU settings.

The two topics with the most new evidence include tPA administration for ischemic stroke and the use of stroke units. These two topics are summarized here.

tPA Improves Outcome When Administered With Strict Criteria

2005 (New): Administration of IV tPA to patients with acute ischemic stroke who meet the National Institute of Neurologic Disorders and Stroke (NINDS) eligibility criteria is recommended if tPA is administered by physicians in the setting of a clearly defined protocol, a knowledgeable team, and institutional commitment (Class I). Note that the superior outcomes reported in both community and tertiary-care hospitals in the NINDS trials have been difficult to replicate in hospitals with less experience in, and institutional commitment to, acute stroke care.

2000 (Old): Intravenous administration of tPA is recommended for carefully selected patients with acute ischemic stroke if they have no contraindications to fibrinolytic therapy and if the drug can be administered within 3 hours of the onset of stroke symptoms (Class I).

Why: The NINDS results have been supported by subsequent 1-year follow-up, reanalysis of the NINDS data, and a meta-analysis. Additional prospective randomized trials, including one just completed in Canada, supported the NINDS results. A recent pair of articles from a hospital consortium documented higher complications of hemorrhage following tPA administration in the first study, when the hospitals did not require strict protocol adherence. The follow-up study (after the hospitals instituted strict protocols) documented a hemorrhage rate lower than that reported in the NINDS trials. Evidence

from prospective randomized studies in adults also documented a greater likelihood of benefit the earlier treatment with tPA is begun.

Many physicians have emphasized the flaws in the NINDS trials. But additional analyses of the original NINDS data by an independent group of investigators confirmed the validity of the results. They verified that improved outcomes in the tPA treatment arm persist even when imbalances in the baseline stroke severity among treatment groups are corrected.

Stroke Units

2005 (New): Multiple randomized clinical trials and meta-analyses in adults document consistent improvement in 1-year survival rate, functional outcomes, and quality of life when patients hospitalized with acute stroke are cared for in a dedicated stroke unit by a multidisciplinary team experienced in managing stroke. When such a facility is available within a reasonable transport interval, stroke patients who require hospitalization should be admitted there (Class I).

2000 (Old): Stroke units were not discussed in the 2000 guidelines.

Why: Although the studies reported were conducted outside the United States in in-hospital units that provided both acute care and rehabilitation, the improved outcomes achieved by stroke units were apparent very early in the stroke care. These results should be relevant to the outcome of dedicated stroke units staffed with experienced multidisciplinary teams in the United States.

Pediatric Advanced Life Support

Emphasis on Effective CPR

The information provided in previous sections about the need for effective CPR applies to the PALS provider. Effective PALS support begins with high-quality PBLs. Rescuers must provide chest compressions of sufficient depth and rate, allowing adequate chest wall recoil, with minimal interruptions in chest compressions. For further information see the BLS for Healthcare Providers section, particularly rescue breaths and emphasis on chest compression rate and depth, complete chest recoil, and minimal interruptions.

The following are the major PALS changes in the 2005 guidelines:

- There is further caution about the use of endotracheal tubes. LMAs are acceptable when used by experienced providers (Class IIb).
- Cuffed endotracheal tubes may be used in infants (except newborns) and children in in-hospital settings provided that cuff inflation pressure is kept <20 cm H₂O.
- Confirmation of tube placement requires clinical assessment and assessment of exhaled carbon dioxide (CO₂); esophageal detector devices may be considered for use in children weighing >20 kg who have a perfusing rhythm (Class IIb). Correct placement must be verified when the tube is inserted, during transport, and whenever the patient is moved.
- During CPR with an advanced airway in place, rescuers will no longer perform “cycles” of CPR. Instead the rescuer performing chest compressions will perform them continuously at a rate of 100/minute without pauses for ventilation. The rescuer providing ventilation will deliver 8 to 10 breaths per minute (1 breath approximately every 6 to 8 seconds). For further information, see the Basic Life Support for Healthcare Providers section.
- More evidence has accumulated to reinforce that vascular access (IV/IO) is preferred to endotracheal drug administration.
- Timing of 1 shock, CPR, and drug administration during pulseless arrest has changed and now is identical to that for ACLS. See ACLS section for details.
- Routine use of high-dose epinephrine is not recommended (Class III).
- Lidocaine is deemphasized, but it can be used for treatment of VF/pulseless VT if amiodarone is not available.
- Induced hypothermia (32°C to 34°C for 12 to 24 hours) may be considered if the child remains comatose after resuscitation (Class IIb).
- Indications for the use of inodilators are mentioned in the postresuscitation section.
- Termination of resuscitative efforts is discussed. It is noted that intact survival has been reported following prolonged

resuscitation and absence of spontaneous circulation despite 2 doses of epinephrine.

Things that have NOT changed in PALS:

- Shock doses for VF/VT (note that the second dose was 2 to 4 J/kg and is now 4 J/kg)
- Shock doses for cardioversion
- Major steps in bradycardia and unstable tachycardia algorithm
- Most drug doses
- Appreciation that most cardiac arrests in infants and children result from a progression of shock or respiratory failure
- Most recommendations for treatments of poisonings and drug overdose

Use of Advanced Airways

2005 (New): Insufficient evidence exists to recommend for or against the routine use of an LMA during cardiac arrest (Class Indeterminate). When endotracheal intubation is not possible, the LMA is an acceptable adjunct for experienced providers (Class IIb), but it is associated with a higher incidence of complications in young children.

Endotracheal intubation in infants and children requires special training because the pediatric airway anatomy differs from the adult airway anatomy. Success and a low complication rate are related to the length of training, supervised experience in the operating room and in the field, adequate ongoing experience, and the use of rapid sequence intubation (RSI).

2000 (Old): The endotracheal tube was considered the ventilation adjunct of choice if used by properly trained providers in a system with monitoring of results and complications. Insufficient evidence was found to recommend for or against use of LMAs in children.

Why: As experience with advanced airways has accumulated, endotracheal intubation by inexperienced providers appears to be associated with a high incidence of misplaced and displaced tubes. In addition, tubes may become displaced when the patient is moved. Providers should be experienced in bag-mask ventilation. If advanced airways are used, providers

must evaluate placement and detect misplacement, and the healthcare system must monitor results.

Use of Cuffed Endotracheal Tubes

2005 (New): In the in-hospital setting, a cuffed endotracheal tube is as safe as an uncuffed tube for infants (except the newborn) and children. In certain circumstances (eg, poor lung compliance, high airway resistance, or a large glottic air leak) a cuffed tube may be preferable, provided that attention is paid to endotracheal tube size, position, and cuff inflation pressure (Class IIa). Keep cuff inflation pressure <20 cm H₂O.

The formula used to estimate the internal diameter of a cuffed tube differs from that used for an uncuffed tube and is as follows:

$$\text{Cuffed endotracheal tube size (mm ID)} \\ = (\text{age in years}/4) + 3$$

2000 (Old): Uncuffed tubes are typically used for children <8 years old. Cuffed tracheal tubes sized for younger children are available and may be appropriate in some circumstances.

Why: Evidence has accumulated that cuffed tubes can be used safely in children.

Verify Correct Tube Placement With Clinical Exam and Device

2005 (New): In infants and children with a perfusing rhythm, use a colorimetric detector or capnography to detect exhaled CO₂ to confirm endotracheal tube position in the prehospital and in-hospital settings (Class IIa) and during intrahospital and interhospital transport (Class IIb). The self-inflating bulb (esophageal detector device) may be considered to confirm endotracheal tube placement in children weighing >20 kg with a perfusing rhythm (Class IIb). Insufficient data exists to make a recommendation for or against its use in children during cardiac arrest (Class Indeterminate).

2000 (Old): Use of exhaled confirmation of placement using an end-tidal CO₂ detector was recommended for children with a perfusing rhythm (Class IIa) and could be considered for children in cardiac arrest (Class IIb). Data was insufficient to make a recommendation about esophageal detector devices in children during cardiac arrest (Class Indeterminate).

Why: The new emphasis is on the need to verify correct tube placement immediately after the tube is inserted, during transport, and especially when the patient is moved. The new wording also does not describe the use of devices as “secondary” confirmation but as “additional” confirmation with clinical assessment (ie, part of the “primary” assessment).

Vascular (IV or IO) Preferred to Endotracheal Drug Administration

2005 (New): Any vascular access, IO or IV, is preferable, but if you cannot establish vascular access, you can give lipid-soluble drugs such as lidocaine, epinephrine, atropine, and naloxone (“LEAN”) via the endotracheal tube, although optimal endotracheal doses are unknown.

2000 (Old): If vascular access is not achieved rapidly in cardiac arrest and the airway is secured, lipid-soluble resuscitation drugs may be administered by the endotracheal route. Whenever a vascular route is available, however, it is preferable to endotracheal drug administration.

Why: There is now a better appreciation that administration of drugs into the trachea results in lower blood concentration than the same dose given by IV route. Recent animal studies suggest that the lower epinephrine concentrations achieved when the drug is delivered by the endotracheal route may produce transient β-adrenergic effects. These effects can be detrimental, causing hypotension, lower coronary artery perfusion pressure and flow, and reduced potential for ROSC. Thus, although endotracheal administration of some resuscitation drugs is possible, IV or IO drug administration is preferred because it will provide more predictable drug delivery and pharmacologic effect.

Timing of Drug Administration During Pulseless Arrest

2005 (New): When drug administration is indicated, the drugs should be administered during CPR, as soon as possible after the rhythm is checked. A drug may be administered during the CPR that is performed while the defibrillator is charging, or during the CPR performed immediately after the shock is delivered. Drug delivery should not interrupt CPR. Rescuers should prepare the next drug dose *before* it is time

for the next rhythm check so that the drug can be administered as soon as possible after the rhythm check (Figures 2 and 3).

2000 (Old): Drugs were administered immediately after a post-shock rhythm check, in a “Drug—CPR—shock” (repeat as needed) cycle. CPR was provided for about a minute after drug administration to circulate the drug before the next rhythm check. Rhythm checks were performed about every minute during attempted resuscitation.

Why: These revisions were proposed to minimize interruptions in chest compressions during attempted resuscitation. The recommendation to provide immediate CPR for 5 cycles or 2 minutes after an attempted shock required a change in the timing of drug administration. The consensus recommendation is to administer the drugs as soon as possible after the rhythm check. The guidelines note that the timing of drug delivery is less important than the need to minimize interruptions in chest compressions.

Routine Use of High-Dose Epinephrine Not Recommended

2005 (New): Use a standard dose (0.01 mg/kg IV/IO) of epinephrine for the first and for subsequent doses (Class IIa). There is no survival benefit from routine use of high-dose (0.1 mg/kg IV/IO) epinephrine, and it may be harmful particularly in asphyxia (Class III). High-dose epinephrine may be considered in exceptional circumstances such as β -blocker overdose (Class IIb). If epinephrine is administered by endotracheal route, use a dose of 0.1 mg/kg.

2000 (Old): The initial dose of epinephrine for cardiac arrest is 0.01 mg/kg given by the IV or IO route or 0.1 mg/kg by the endotracheal route. Higher doses (0.1 to 0.2 mg/kg) by any intravascular route may be considered (Class IIb).

Why: A prospective randomized controlled trial documented that routine use of high-dose epinephrine failed to improve outcome from cardiac arrest in children and actually was associated with worse outcome. In some special situations, such as drug overdose, high-dose epinephrine may be considered.

Rhythm Disturbances and Defibrillation

2005 (New): The only change in treating arrhythmias is to deemphasize the value of lidocaine compared with amiodarone in

treating VT and preventing VF. Both are still listed in the algorithm. The text says “give amiodarone (Class IIb) or lidocaine if you do not have amiodarone.”

The changes in the timing of drug administration in treating pulseless arrest, the use of 1 shock followed immediately by CPR (beginning with compressions), and the need to lessen interruptions in chest compressions are the same as those presented for ACLS.

The algorithm for treatment of tachycardia with adequate perfusion is not included in the 2005 guidelines because tachycardia with adequate perfusion does not require resuscitation. The algorithm is included in the *ECC Handbook* and training materials.

The superiority and greater safety of biphasic over monophasic shocks for defibrillation are emphasized. With manual biphasic or monophasic defibrillation, the initial dose remains 2 J/kg. Subsequent shock doses are 4 J/kg (this represents a slight modification of the second shock dose).

2000 (Old): Amiodarone may be used for VF/pulseless VT (Class Indeterminate). The defibrillation doses were 2 J/kg, then 2 to 4 J/kg, then 4 J/kg.

Why: Accumulating evidence (although largely in children with perfusing rhythms) shows that lidocaine is less effective than amiodarone. The defibrillation dose remains largely unchanged because there is no human data on effective biphasic defibrillation doses in children.

Postresuscitation Care

2005 (New): The 2005 guidelines emphasize the importance of avoiding hyperthermia and the possible benefits of induced hypothermia (32°C to 34°C) for 12 to 24 hours for patients who remain comatose after resuscitation from cardiac arrest (Class IIb). Providers should monitor temperature and treat fever aggressively (Class IIb).

The 2005 guidelines also indicate the probable beneficial effects of vasoactive medications, including inodilators, to treat postresuscitation myocardial depression. The adverse effects on the cerebral circulation of hyperventilation are noted.

Intact survival has been reported following prolonged resuscitation and absence of

spontaneous circulation despite 2 doses of epinephrine.

2000 (Old): Data was insufficient to recommend routine application of hypothermia, although the guidelines acknowledged that postarrest or postschismic hypothermia could have beneficial effects on neurologic function. Active cooling to treat hyperthermia was recommended (Class IIa). If a child fails to respond to at least 2 doses of epinephrine with ROSC, the child is unlikely to survive.

Why: Two positive randomized controlled trials in adults and trials of head and body cooling in neonates suggest the beneficial effects of cooling following an ischemic injury. More data is needed in children. Myocardial dysfunction will be present following resuscitation, and providers must be prepared to treat it. More data is available on the detrimental effects of hyperventilation, so it is no longer recommended for routine care. The intact survival of some children following prolonged resuscitation indicates our need to identify better prognostic indicators than the length of the resuscitative effort.

Neonatal Resuscitation

Care of the newborn, particularly in the first hours after birth, requires rapid and careful assessment and then focus on initial stabilization, ventilation, and (if needed) chest compressions and administration of epinephrine or volume expansion. The major priority for newborn resuscitation is establishment of effective ventilation and oxygenation. For the 2005 guidelines, additional evidence was available about the use of oxygen versus room air for resuscitation, the need for clearing the airway of meconium, methods of assisting ventilation, techniques for confirming endotracheal tube placement, and use of the LMA.

Use of Oxygen During Resuscitation

2005 (New): Supplementary oxygen is recommended whenever positive-pressure ventilation is indicated for resuscitation; free-flow oxygen should be administered to babies who are breathing but have central cyanosis (Class Indeterminate). Although the standard approach to resuscitation is to use 100% oxygen, it is reasonable to begin resuscitation with an oxygen concentration

of less than 100% or to start with no supplementary oxygen (ie, start with room air). If the clinician begins resuscitation with room air, it is recommended that supplementary oxygen be available to use if there is no appreciable improvement within 90 seconds after birth. In situations where supplementary oxygen is not readily available, positive-pressure ventilation should be administered with room air (Class Indeterminate).

2000 (Old): If cyanosis, bradycardia, or other signs of distress were noted in a breathing newborn during stabilization, administration of 100% oxygen was indicated while determining the need for additional intervention.

Why: Scientists are concerned about the potential adverse effects of 100% oxygen on respiratory physiology and cerebral circulation and the potential tissue damage from oxygen free radicals. Conversely they are also concerned about tissue damage from oxygen deprivation during and after asphyxia. Clinical studies about use of room air or oxygen have yielded contradictory results, and some studies had methodologic limitations.

Clearing the Airway of Meconium

2005 (New): Current recommendations no longer advise routine intrapartum oropharyngeal and nasopharyngeal suctioning for infants born to mothers with meconium staining of amniotic fluid (Class D). Randomized controlled trials have shown that this practice offers no benefit if the infant is vigorous (Class I). Endotracheal suctioning for infants who are not vigorous should be performed immediately after birth (Class Indeterminate).

2000 (Old): If the amniotic fluid contains meconium and the infant has absent or depressed respirations, decreased muscle tone, or heart rate <100 bpm, perform direct laryngoscopy immediately after birth for suctioning of residual meconium from the hypopharynx and intubation/suction of the trachea. Evidence shows that tracheal suctioning of the vigorous infant with meconium-stained fluid does not improve outcome and may cause complications (Class I).

Why: A 2004 multicenter randomized trial gave further weight to the recommendations.

Devices for Assisting Ventilation

2005 (New): A self-inflating bag, a flow-inflating bag, or a T-piece (a valved mechanical device designed to regulate pressure and limit flow) can be used to ventilate a newborn (Class IIb).

Case reports suggest that the LMA can be a reasonable alternative to intubation in special cases, particularly when providers are experienced with the use of the device in preterm infants. Insufficient evidence exists to support the routine use of the LMA as the primary airway device during neonatal resuscitation, in the setting of meconium-stained amniotic fluid, when chest compressions are required, in very-low-birth-weight babies, or for delivery of emergency intratracheal medications (Class Indeterminate).

2000 (Old): T-pieces were not discussed in the 2000 guidelines. Evidence was insufficient to recommend for or against the LMA (Class Indeterminate).

Why: T-piece resuscitators are now recognized as acceptable devices for administering positive pressure during resuscitation of the newborn, but personnel should also be familiar with bag-mask equipment and technique.

Indication of Adequate Ventilation and Confirmation of Endotracheal Tube Placement

2005 (New): An increase in heart rate is the primary sign of improved ventilation during resuscitation. Exhaled CO₂ detection is the recommended primary technique to confirm correct endotracheal tube placement when a prompt increase in heart rate does not occur after intubation (Class IIa). Evidence is insufficient to recommend for or against the use of esophageal detector devices.

2000 (Old): The use of exhaled CO₂ detection was thought to be useful in the secondary confirmation of tracheal intubation in the newly born, particularly when clinical assessment was equivocal (Class Indeterminate).

Why: More evidence is available about the reliability of exhaled CO₂ detection to confirm correct placement of endotracheal tubes. The PALS section notes that there is insufficient evidence about the use of

esophageal detector devices in patients aged <1 year (weight <20 kg) to recommend their use.

Drug Therapy

2005 (New): The recommended IV epinephrine dose is 0.01 to 0.03 mg/kg per dose. Higher IV doses are not recommended (Class III), and IV administration is the preferred route (Class IIa). While access is being obtained, administration of a higher dose (up to 0.1 mg/kg) through the endotracheal tube may be considered (Class Indeterminate).

Naloxone administration is not recommended during the primary steps of resuscitation, and endotracheal naloxone is not recommended (Class Indeterminate). Naloxone should be avoided in babies whose mothers are suspected of having had long-term exposure to opioids (Class Indeterminate).

2000 (Old): The same IV dose of epinephrine was recommended in 2000. Evidence was inadequate to support the routine use of higher doses of epinephrine (Class Indeterminate). Naloxone administration was recommended intravenously, endotracheally, or—if perfusion was adequate—intramuscularly or subcutaneously. In 2000 the tracheal route was the most rapidly accessible.

Why: The prospective randomized trial in pediatrics and the absence of data on effectiveness of high-dose IV epinephrine led to the recommendation that it should not be used in neonates. Because naloxone can be given by many routes and its absorption by the endotracheal route may be unpredictable, this drug should be given by other than endotracheal route.

Temperature Control

2005 (New): Although there is new data (including a second study published in October 2005), the data is insufficient to recommend routine use of modest systemic or selective cerebral hypothermia after resuscitation of infants with suspected asphyxia (Class Indeterminate). Further clinical trials are needed to determine which infants benefit most and which method of cooling is most effective. Avoidance of hyperthermia (elevated body temperature) is particularly important in babies who may have had a hypoxic-ischemic event.

Polyethylene bags may help maintain body temperature during resuscitation of very-low-birth-weight babies.

2000 (Old): In 2000 induced hypothermia was acknowledged as a promising area of research, but evidence was insufficient to recommend routine implementation (Class Indeterminate). The polyethylene bags were not mentioned for temperature control.

Why: In a multicenter trial involving newborns with suspected asphyxia (indicated by need for resuscitation at birth, metabolic acidosis, and early encephalopathy), selective head cooling (34°C to 35°C) was associated with a nonsignificant reduction in the overall number of survivors with severe disability at 18 months. The trial showed a significant benefit in the subgroup with moderate encephalopathy. Infants with severe electrographic suppression and seizures did not benefit from treatment with modest hypothermia. A second small controlled pilot study in asphyxiated infants with early induced systemic hypothermia found fewer deaths and disability at 12 months. In October 2005 a third positive study of hypothermia was published. Further data is needed about the technique of induction of hypothermia and support required during the hypothermia.

Polyethylene bags have been effective in helping the newborn maintain body temperature.

Withholding or Withdrawing Therapy

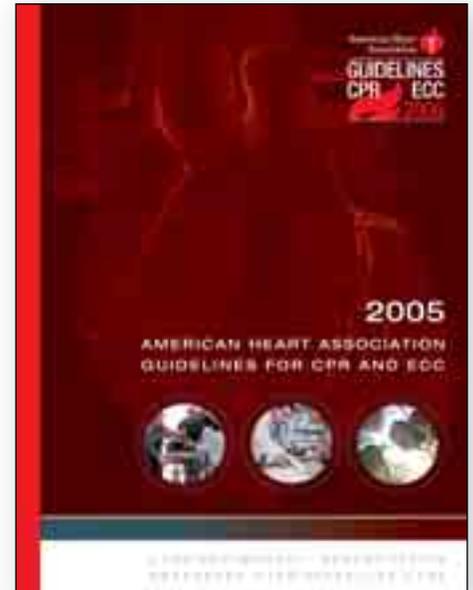
2005 (New): It is possible to identify conditions associated with high mortality and poor outcome in which withholding resuscitative efforts may be considered

reasonable, particularly when there has been the opportunity for parental agreement. The following guidelines must be interpreted according to current regional outcomes:

- When gestation, 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 (Class IIa). Examples are provided in the guidelines.
- In conditions associated with a high rate of survival and acceptable morbidity, resuscitation is nearly always indicated (Class IIa).
- In conditions associated with uncertain prognosis in which 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 Indeterminate).

Infants without signs of life (no heartbeat and no respiratory effort) after 10 minutes of resuscitation show either a high mortality rate or severe neurodevelopmental disability. After 10 minutes of continuous and adequate resuscitative efforts, discontinuation of resuscitation may be justified if there are no signs of life (Class IIb).

2000 (Old): Noninitiation or discontinuation of resuscitation in the delivery room may be appropriate in some circumstances. National and local protocols should dictate the procedures to be followed. Examples were provided in the guidelines of such potential circumstances.



Why: More evidence has accumulated to identify conditions associated with high mortality and poor outcome. Under those conditions withholding resuscitative efforts may be considered reasonable, particularly when there has been the opportunity for parental agreement.

SUMMARY

This issue of *Currents* highlights many of the major changes in the *2005 AHA Guidelines for CPR and ECC*. This document provides only a quick review and does not include the scientific background or details contained in the guidelines publication. Resuscitation clinicians and researchers should also read the complete guidelines document, published in the Dec 13, 2005, issue of the AHA journal *Circulation*. Also recommended is the *2005 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care With Treatment Recommendations* (summary of the international review of the science), published in the Nov 29, 2005, issue of *Circulation*. Both publications are available free of charge at <http://www.circulationaha.org>.

TABLE 3. Applying Classification of Recommendations and Level of Evidence

Class I	Class IIa	Class IIb	Class III
Benefit >>> Risk Procedure/treatment or diagnostic test/assessment should be performed/administered.	Benefit >> Risk It is reasonable to perform procedure/administer treatment or perform diagnostic test/assessment.	Benefit ≥ Risk Procedure/treatment or diagnostic test/assessment may be considered.	Risk ≥ Benefit Procedure/treatment or diagnostic test/assessment should not be performed/administered. It is not helpful and may be harmful
Class Indeterminate <ul style="list-style-type: none"> • Research just getting started • Continuing area of research • No recommendations until further research (ie, cannot recommend for or against) 			

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