
American
Heart
Association
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GUIDELINES
2015 CPR & ECC
HIGHLIGHTS
of the 2015 American Heart Association
Guidelines Update for CPR and ECC
2015

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# Introduction

This "Guidelines Highlights" publication summarizes the key issues and changes in the *2015 American Heart Association* (AHA) *Guidelines Update for Cardiopulmonary Resuscitation* (CPR) *and Emergency Cardiovascular Care* (ECC). It has been developed for resuscitation providers and for AHA instructors to focus on the resuscitation science and guidelines recommendations that are most significant or controversial or those that will result in changes in resuscitation practice or resuscitation training. In addition, it provides the rationale for the recommendations.

Because this publication is designed as a summary, it does not reference the supporting published studies and does not list Classes of Recommendation or Levels of Evidence.

For more detailed information and references, readers are encouraged to read the *2015 AHA Guidelines Update for CPR and ECC*, including the Executive Summary,[1] published in *Circulation* in October 2015, and to consult the detailed summary of resuscitation science in the *2015 International Consensus on CPR and ECC Science With Treatment Recommendations*, published simultaneously in *Circulation*[2] and *Resuscitation*.[3]

The *2015 AHA Guidelines Update for CPR and ECC* is based on an international evidence evaluation process that involved 250 evidence reviewers from 39 countries. The process for the 2015 International Liaison Committee on Resuscitation (ILCOR) systematic review was quite different when compared with the process used in 2010. For the 2015 systematic review process, the ILCOR task forces prioritized topics for review, selecting those where there was

**Figure 1**

## New AHA Classification System for Classes of Recommendation and Levels of Evidence*

### CLASS (STRENGTH) OF RECOMMENDATION

**CLASS I (STRONG)** — **Benefit >>> Risk**

Suggested phrases for writing recommendations:
- Is recommended
- Is indicated/useful/effective/beneficial
- Should be performed/administered/other
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is recommended/indicated in preference to treatment B
  - Treatment A should be chosen over treatment B

**CLASS IIa (MODERATE)** — **Benefit >> Risk**

Suggested phrases for writing recommendations:
- Is reasonable
- Can be useful/effective/beneficial
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is probably recommended/indicated in preference to treatment B
  - It is reasonable to choose treatment A over treatment B

**CLASS IIb (WEAK)** — **Benefit ≥ Risk**

Suggested phrases for writing recommendations:
- May/might be reasonable
- May/might be considered
- Usefulness/effectiveness is unknown/unclear/uncertain or not well established

**CLASS III: No Benefit (MODERATE)** — **Benefit = Risk**
*(Generally, LOE A or B use only)*

Suggested phrases for writing recommendations:
- Is not recommended
- Is not indicated/useful/effective/beneficial
- Should not be performed/administered/other

**CLASS III: Harm (STRONG)** — **Risk > Benefit**

Suggested phrases for writing recommendations:
- Potentially harmful
- Causes harm
- Associated with excess morbidity/mortality
- Should not be performed/administered/other

### LEVEL (QUALITY) OF EVIDENCE‡

**LEVEL A**
- High-quality evidence‡ from more than 1 RCTs
- Meta-analyses of high-quality RCTs
- One or more RCTs corroborated by high-quality registry studies

**LEVEL B-R (Randomized)**
- Moderate-quality evidence‡ from 1 or more RCTs
- Meta-analyses of moderate-quality RCTs

**LEVEL B-NR (Nonrandomized)**
- Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies
- Meta-analyses of such studies

**LEVEL C-LD (Limited Data)**
- Randomized or nonrandomized observational or registry studies with limitations of design or execution
- Meta-analyses of such studies
- Physiological or mechanistic studies in human subjects

**LEVEL C-EO (Expert Opinion)**

Consensus of expert opinion based on clinical experience

COR and LOE are determined independently (any COR may be paired with any LOE).

A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

* The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).

† For comparative-effectiveness recommendations (COR I and IIa; LOE A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

‡ The method of assessing quality is evolving, including the application of standardized, widely used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.

COR indicates Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

sufficient new science or controversy to prompt a systematic review. As a result of this prioritization, there were fewer reviews completed in 2015 (166) than in 2010 (274).

Once the topics were selected, there were 2 important additions to the 2015 process of review itself. First, reviewers used Grading of Recommendations Assessment, Development, and Evaluation (GRADE; www.gradeworkinggroup.org), a highly structured and reproducible evidence review system, to improve the consistency and quality of the 2015 systematic reviews. Second, reviewers from around the world were able to work together virtually to complete the systematic reviews through the use of a purpose-built AHA Web-based platform, the Systematic Evidence Evaluation and Review System (SEERS), designed to support the many steps of the evaluation process. This SEERS site was used to provide public disclosure of drafts of the ILCOR *2015 International Consensus on CPR and ECC Science With Treatment Recommendations* and to receive public comment. To learn more about SEERS and to see a comprehensive list of all systematic reviews conducted by ILCOR, visit www.ilcor.org/seers.

**The *2015 AHA Guidelines Update for CPR and ECC* is very different from previous editions of the AHA Guidelines for CPR and ECC.** The ECC Committee determined that this 2015 version would be an *update*, addressing *only* those topics addressed by the 2015 ILCOR evidence review or those requested by the training network. This decision ensures that we have only one standard for evidence evaluation, and that is the process created by ILCOR. As a result, the *2015 AHA Guidelines Update for CPR and ECC* is not a comprehensive revision of the *2010 AHA Guidelines for CPR and ECC*. Such an integrated version is available online at ECCguidelines.heart.org.

The publication of the *2015 International Consensus on CPR and ECC Science With Treatment Recommendations* begins a process of ongoing review of resuscitation science. The topics reviewed in 2015 will be updated as needed and new topics will be added. Readers will want to monitor the SEERS site to keep up-to-date on the newest resuscitation science and the ILCOR evaluation of that science. When sufficient evidence emerges that indicates the need to change the AHA Guidelines for CPR and ECC, such changes will be made and communicated to clinicians and to the training network.

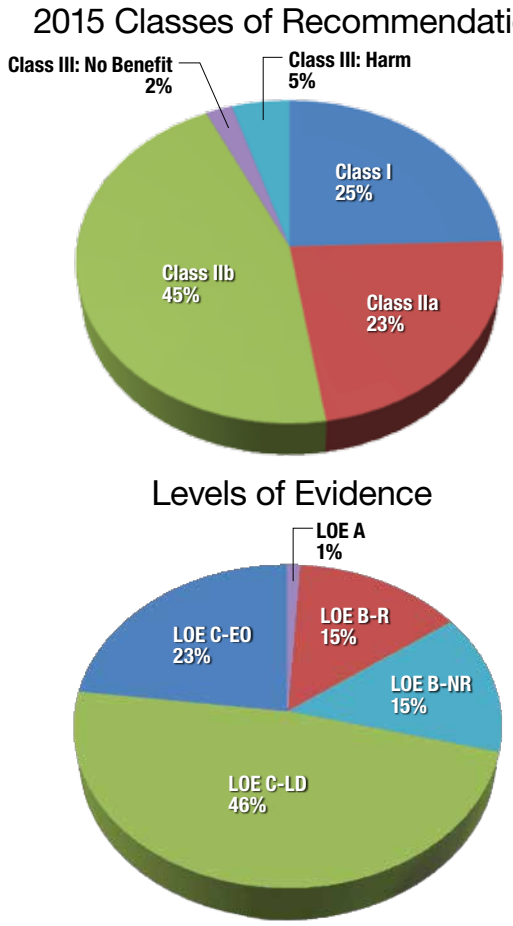
The 2015 Guidelines Update used the most recent version of the AHA definitions for the Classes of Recommendation and Levels of Evidence (Figure 1). Readers will note that this version contains a modified Class III recommendation, Class III: No Benefit, to be used infrequently when evidence suggests a strategy is demonstrated by a high- or moderate-quality study (Level of Evidence [LOE] A or B, respectively) to be no better than the control. The Levels of Evidence have also been modified. LOE B is now divided into LOE B-R (randomized studies) and LOE B-NR (nonrandomized studies). LOE C is now divided into LOE C-LD (limited data) and C-EO (expert opinion).

As outlined in the recently published Institute of Medicine report[4] and the AHA ECC consensus response to this report,[5] more needs to be done to advance the science and practice of resuscitation. There must be a concerted effort to fund cardiac arrest resuscitation research similar to what has driven cancer and stroke research over the past 2 decades. The gaps in the science are clear when the recommendations contained within the 2015 Guidelines Update are scrutinized (Figure 2). Collectively, the Levels of Evidence and the Classes of Recommendation in resuscitation are low, with only 1% of the total recommendations in 2015 (3 of 315) based on the highest Level of Evidence (LOE A) and only 25% of the recommendations (78 of 315) designated as Class I (strong recommendation). Most (69%) of the 2015 Guidelines Update recommendations are supported by the lowest Levels of Evidence (LOE C-LD or C-EO), and nearly half (144 of 315; 45%) are categorized as Class IIb (weak recommendation).

Throughout the ILCOR evidence evaluation process and the 2015 Guidelines Update development, participants adhered strictly to the AHA conflict of interest disclosure requirements. The AHA staff processed more than 1000 conflict of interest disclosures, and all Guidelines writing group chairs and at least 50% of Guidelines writing group members were required to be free of relevant conflicts of interest.

**Figure 2**

**Distribution of Classes of Recommendation and Levels of Evidence as Percent of 315 Total Recommendations in 2015 AHA Guidelines Update**




Percent of 315 recommendations.

## Ethical Issues

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

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

### Significant New and Updated Recommendations That May Inform Ethical Decisions

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

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

There is greater awareness that although children and adolescents cannot make legally binding decisions, information should be shared with them to the extent possible, using appropriate language and information for each patient's level of development. In addition, the phrase *limitations of care* has been changed to *limitations of interventions*, and there is increasing availability of the Physician Orders for Life-Sustaining Treatment (POLST) form, a new method of legally identifying people with specific limits on interventions at the end of life, both in and out of healthcare facilities. Even with new information that the success of kidney and liver transplants from adult donors is unrelated to whether the donor receives CPR, the donation of organs after resuscitation remains controversial. Viewpoints on several important ethical concerns that are the topics of ongoing debate around organ donation in an emergency setting are summarized in "Part 3: Ethical Issues" of the 2015 Guidelines Update.

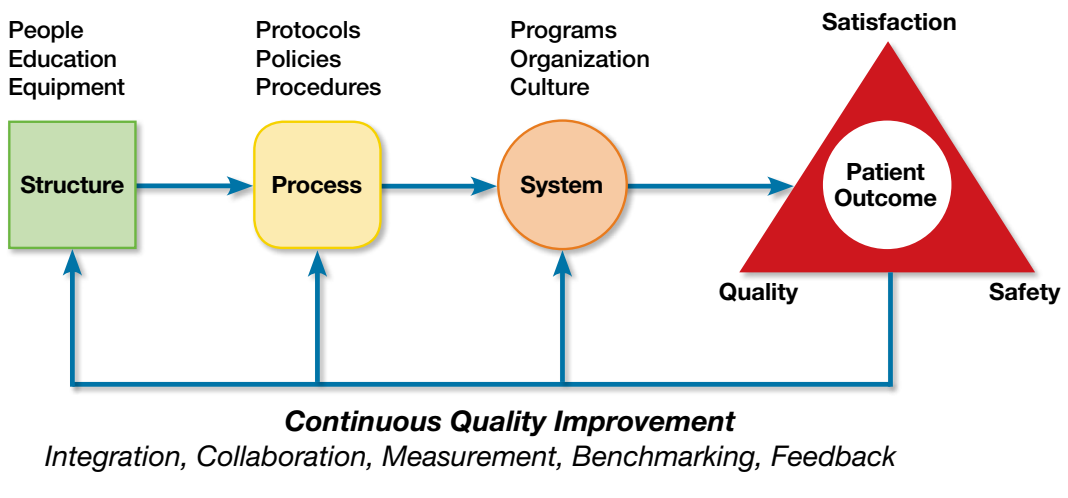
## Systems of Care and Continuous Quality Improvement

The 2015 Guidelines Update provides stakeholders with a new perspective on systems of care, differentiating in-hospital cardiac arrests (IHCAs) from out-of-hospital cardiac arrests (OHCAs). Major highlights include

- A universal taxonomy of systems of care
- Separation of the AHA adult Chain of Survival into 2 chains: one for in-hospital and one for out-of-hospital systems of care
- Review of best evidence on how these cardiac arrest systems of care are reviewed, with a focus on cardiac arrest, ST-segment elevation myocardial infarction (STEMI), and stroke

**Figure 3**

**Taxonomy of Systems of Care: SPSO**



## Components of a System of Care

**2015 (New):** Universal elements of a system of care have been identified to provide stakeholders with a common framework with which to assemble an integrated resuscitation system (Figure 3).

**Why:** Healthcare delivery requires structure (eg, people, equipment, education) and process (eg, policies, protocols, procedures) that, when integrated, produce a system (eg, programs, organizations, cultures) that leads to optimal outcomes (eg, patient survival and safety, quality, satisfaction). An effective system of care comprises all of these elements—structure, process, system, and patient outcomes—in a framework of continuous quality improvement.

## Chains of Survival

**2015 (New):** Separate Chains of Survival (Figure 4) have been recommended that identify the different pathways of care for patients who experience cardiac arrest in the hospital as distinct from out-of-hospital settings.

**Why:** The care for all post–cardiac arrest patients, regardless of where their arrests occur, converges in the hospital, generally in an intensive care unit where post–cardiac arrest care is provided. The elements of structure and process that are required before that convergence are very different for the 2 settings. Patients who have an OHCA depend on their community for support. Lay rescuers must recognize the arrest, call for help, and initiate CPR and provide defibrillation (ie, public-access defibrillation [PAD]) until a team of professionally trained emergency medical service (EMS) providers assumes responsibility and then transports the patient to an emergency department and/or cardiac catheterization lab. The patient is ultimately transferred to a critical care unit for continued care. In contrast, patients who have an IHCA depend on a system of appropriate surveillance (eg, rapid response or early warning system) to prevent cardiac arrest. If cardiac arrest occurs, patients depend on the smooth interaction of the institution's various departments and services and on a multidisciplinary team of professional providers, including physicians, nurses, respiratory therapists, and others.

## Use of Social Media to Summon Rescuers

**2015 (New):** It may be reasonable for communities to incorporate social media technologies that summon rescuers who are in close proximity to a victim of suspected OHCA and are willing and able to perform CPR.

**Why:** There is limited evidence to support the use of social media by dispatchers to notify potential rescuers of a possible

**Figure 4**

### IHCA and OHCA Chains of Survival

cardiac arrest nearby, and activation of social media has not been shown to improve survival from OHCA. However, in a recent study in Sweden, there was a significant increase in the rate of bystander-initiated CPR when a mobile-phone dispatch system was used.[6] Given the low harm and the potential benefit, as well as the ubiquitous presence of digital devices, municipalities could consider incorporating these technologies into their OHCA systems of care.

## Team Resuscitation: Early Warning Sign Systems, Rapid Response Teams, and Medical Emergency Team Systems

**2015 (Updated):** For adult patients, rapid response team (RRT) or medical emergency team (MET) systems can be effective in reducing the incidence of cardiac arrest, particularly in the general care wards. Pediatric MET/RRT systems may be considered in facilities where children with high-risk illnesses are cared for in general in-patient units. The use of early warning sign systems may be considered for adults and children.

**2010 (Old):** Although conflicting evidence exists, expert consensus recommended the systematic identification of patients at risk of cardiac arrest, an organized response to such patients, and an evaluation of outcomes to foster continuous quality improvement.

**Why:** RRTs or METs were established to provide early intervention for patients with clinical deterioration, with the goal of preventing IHCA. Teams can be composed of varying combinations of physicians, nurses, and respiratory therapists. These teams are usually summoned to a patient bedside when acute deterioration is identified by hospital staff. The team typically brings emergency monitoring and resuscitation equipment and drugs. Although the evidence is still evolving, there is face validity in the concept of having teams trained in the complex choreography of resuscitation.

## Continuous Quality Improvement for Resuscitation Programs

**2015 (Reaffirmation of 2010):** Resuscitation systems should establish ongoing assessment and improvement of systems of care.

**Why:** There is evidence of considerable regional variation in the reported incidence and outcome of cardiac arrest in the United States. This variation underscores the need for communities and systems to accurately identify each occurrence of treated cardiac arrest and to record outcomes. There are likely to be opportunities to improve survival rates in many communities.

Community- and hospital-based resuscitation programs should systematically monitor cardiac arrests, the level of resuscitation care provided, and outcome. Continuous quality improvement includes systematic evaluation and feedback, measurement or benchmarking, and analysis. Continuous efforts are needed to optimize resuscitation care so that the gaps between ideal and actual resuscitation performance can be narrowed.

## Regionalization of Care

**2015 (Reaffirmation of 2010):** A regionalized approach to OHCA resuscitation that includes the use of cardiac resuscitation centers may be considered.

**Why:** A cardiac resuscitation center is a hospital that provides evidence-based care in resuscitation and post–cardiac arrest care, including 24-hour, 7-day percutaneous coronary intervention (PCI) capability, TTM with an adequate annual volume of cases, and commitment to ongoing performance improvement that includes measurement, benchmarking, and both feedback and process change. It is hoped that resuscitation systems of care will achieve the improved survival rates that followed establishment of other systems of care, such as trauma.

# Adult Basic Life Support and CPR Quality: Lay Rescuer CPR

## Summary of Key Issues and Major Changes

Key issues and major changes in the 2015 Guidelines Update recommendations for adult CPR by lay rescuers include the following:

- The crucial links in the out-of-hospital adult Chain of Survival are unchanged from 2010, with continued emphasis on the simplified universal Adult Basic Life Support (BLS) Algorithm.
- The Adult BLS Algorithm has been modified to reflect the fact that rescuers can activate an emergency response (ie, through use of a mobile telephone) without leaving the victim's side.
- It is recommended that communities with people at risk for cardiac arrest implement PAD programs.
- Recommendations have been strengthened to encourage immediate recognition of unresponsiveness, activation of the emergency response system, and initiation of CPR if the lay rescuer finds an unresponsive victim is not breathing or not breathing normally (eg, gasping).
- Emphasis has been increased about the rapid identification of potential cardiac arrest by dispatchers, with immediate provision of CPR instructions to the caller (ie, dispatch-guided CPR).
- The recommended sequence for a single rescuer has been confirmed: the single rescuer is to initiate chest compressions before giving rescue breaths (C-A-B rather than A-B-C) to reduce delay to first compression. The single rescuer should begin CPR with 30 chest compressions followed by 2 breaths.
- There is continued emphasis on the characteristics of high-quality CPR: compressing the chest at an adequate rate and depth, allowing complete chest recoil after each compression, minimizing interruptions in compressions, and avoiding excessive ventilation.
- The recommended chest compression rate is 100 to 120/min (updated from *at least* 100/min).
- The clarified recommendation for chest compression depth for adults is at least 2 inches (5 cm) but not greater than 2.4 inches (6 cm).
- Bystander-administered naloxone may be considered for suspected life-threatening opioid-associated emergencies.

These changes are designed to simplify lay rescuer training and to emphasize the need for early chest compressions for victims of sudden cardiac arrest. More information about these changes appears below.

In the following topics, changes or points of emphasis that are similar for lay rescuers and HCPs are noted with an asterisk (*).

## Community Lay Rescuer AED Programs

**2015 (Updated):** It is recommended that PAD programs for patients with OHCA be implemented in public locations where there is a relatively high likelihood of witnessed cardiac arrest (eg, airports, casinos, sports facilities).

**2010 (Old):** CPR and the use of automated external defibrillators (AEDs) by public safety first responders were recommended to increase survival rates for out-of-hospital sudden cardiac arrest. The 2010 Guidelines recommended the establishment of AED programs in public locations where there is a relatively high likelihood of witnessed cardiac arrest (eg, airports, casinos, sports facilities).

**Why:** There is clear and consistent evidence of improved survival from cardiac arrest when a bystander performs CPR and rapidly uses an AED. Thus, immediate access to a defibrillator is a primary component of the system of care. The implementation of a PAD program requires 4 essential components: (1) a planned and practiced response, which ideally includes identification of locations and neighborhoods where there is high risk of cardiac arrest, placement of AEDs in those areas and ensuring that bystanders are aware of the location of the AEDs, and, typically, oversight by an HCP; (2) training of anticipated rescuers in CPR and use of the AED; (3) an integrated link with the local EMS system; and (4) a program of ongoing quality improvement.

A system-of-care approach for OHCA might include public policy that encourages reporting of public AED locations to public service access points (PSAPs; the term *public service access point* has replaced the less-precise *EMS dispatch center*). Such a policy would enable PSAPs to direct bystanders to retrieve nearby AEDs and assist in their use when OHCA occurs. Many municipalities as well as the US federal government have enacted legislation to place AEDs in municipal buildings, large public venues, airports, casinos, and schools. For the 20% of OHCAs that occur in public areas, these community programs represent an important link in the Chain of Survival between recognition and activation of the PSAPs. This information is expanded in “Part 4: Systems of Care and Continuous Quality Improvement” in the 2015 Guidelines Update.

There is insufficient evidence to recommend for or against the deployment of AEDs in homes. Victims of OHCAs that occur in private residences are much less likely to receive chest compressions than are patients who experience cardiac arrest in public settings. Real-time instructions provided by emergency dispatchers may help potential in-home rescuers to initiate action. Robust community CPR training programs for cardiac arrest, along with effective, prearrival dispatch protocols, can improve outcomes.

## Dispatcher Identification of Agonal Gasps

Cardiac arrest victims sometimes present with seizure-like activity or agonal gasps that can confuse potential rescuers. Dispatchers should be specifically trained to identify these presentations of cardiac arrest to enable prompt recognition and immediate dispatcher-guided CPR.

**2015 (Updated):** To help bystanders recognize cardiac arrest, dispatchers should inquire about a victim’s absence of responsiveness and quality of breathing (normal versus not normal). If the victim is unresponsive with absent or abnormal breathing, the rescuer and the dispatcher should assume that the victim is in cardiac arrest. Dispatchers should be educated to identify unresponsiveness with abnormal and agonal gasps across a range of clinical presentations and descriptions.

**2010 (Old):** To help bystanders recognize cardiac arrest, dispatchers should ask about an adult victim’s responsiveness, if the victim is breathing, and if the breathing is normal, in an attempt to distinguish victims with agonal gasps (ie, in those who need CPR) from victims who are breathing normally and do not need CPR.

**Why:** This change from the 2010 Guidelines emphasizes the role that emergency dispatchers can play in helping the lay rescuer recognize absent or abnormal breathing.

Dispatchers should be specifically educated to help bystanders recognize that agonal gasps are a sign of cardiac arrest. Dispatchers should also be aware that brief generalized seizures may be the first manifestation of cardiac arrest. In summary, in addition to activating professional emergency responders, the dispatcher should ask straightforward questions about whether the patient is unresponsive and if breathing is normal or abnormal in order to identify patients with possible cardiac arrest and enable dispatcher-guided CPR.

## Emphasis on Chest Compressions*

**2015 (Updated):** Untrained lay rescuers should provide compression-only (Hands-Only) CPR, with or without dispatcher guidance, for adult victims of cardiac arrest. The rescuer should continue compression-only CPR until the arrival of an AED or rescuers with additional training. All lay rescuers should, at a minimum, provide chest compressions for victims of cardiac arrest. In addition, if the trained lay rescuer is able to perform rescue breaths, he or she should add rescue breaths in a ratio of 30 compressions to 2 breaths. The rescuer should continue CPR until an AED arrives and is ready for use, EMS providers take over care of the victim, or the victim starts to move.

**2010 (Old):** If a bystander is not trained in CPR, the bystander should provide compression-only CPR for the adult victim who suddenly collapses, with an emphasis to “push hard and fast” on the center of the chest, or follow the directions of the EMS dispatcher. The rescuer should continue compression-only CPR until an AED arrives and is ready for use or EMS providers take over care of the victim. All trained lay rescuers should, at a minimum,

provide chest compressions for victims of cardiac arrest. In addition, if the trained lay rescuer is able to perform rescue breaths, compressions and breaths should be provided in a ratio of 30 compressions to 2 breaths. The rescuer should continue CPR until an AED arrives and is ready for use or EMS providers take over care of the victim.

**Why:** Compression-only CPR is easy for an untrained rescuer to perform and can be more effectively guided by dispatchers over the telephone. Moreover, survival rates from adult cardiac arrests of cardiac etiology are similar with either compression-only CPR or CPR with both compressions and rescue breaths when provided before EMS arrival. However, for the trained lay rescuer who is able, the recommendation remains for the rescuer to perform both compressions and breaths.

## Chest Compression Rate*

**2015 (Updated):** In adult victims of cardiac arrest, it is reasonable for rescuers to perform chest compressions at a rate of 100 to 120/min.

**2010 (Old):** It is reasonable for lay rescuers and HCPs to perform chest compressions at a rate of at least 100/min.

**Why:** The number of chest compressions delivered per minute during CPR is an important determinant of return of spontaneous circulation (ROSC) and survival with good neurologic function. The actual number of chest compressions delivered per minute is determined by the rate of chest compressions and the number and duration of interruptions in compressions (eg, to open the airway, deliver rescue breaths, allow AED analysis). In most studies, more compressions are associated with higher survival rates, and fewer compressions are associated with lower survival rates. Provision of adequate chest compressions requires an emphasis not only on an adequate compression rate but also on minimizing interruptions to this critical component of CPR. An inadequate compression rate or frequent interruptions (or both) will reduce the total number of compressions delivered per minute. New to the 2015 Guidelines Update are upper limits of recommended compression rate and compression depth, based on preliminary data suggesting that excessive compression rate and depth adversely affect outcomes. The addition of an upper limit of compression rate is based on 1 large registry study analysis associating extremely rapid compression rates (greater than 140/min) with inadequate compression depth. Box 1 uses the analogy of automobile travel to explain the effect of compression rate and interruptions on total number of compressions delivered during resuscitation.

**Box 1**

### Number of Compressions Delivered Affected by Compression Rate and by Interruptions

The total number of compressions delivered during resuscitation is an important determinant of survival from cardiac arrest.

- The number of compressions delivered is affected by the compression *rate* (the frequency of chest compressions per minute) and by the compression *fraction* (the portion of total CPR time during which compressions are performed). Increases in compression rate and fraction increase the total number of compressions delivered. Compression fraction is improved by reducing the number and duration of any interruptions in compressions.
- An analogy can be found in automobile travel. When traveling in an automobile, the number of miles traveled in a day is affected not only by the speed (rate of travel) but also by the number and duration of any stops (interruptions in travel). Traveling 60 mph without interruptions translates to an actual travel distance of 60 miles in an hour. Traveling 60 mph except for a 10-minute stop translates to an actual travel of 50 miles in that hour. The more frequent and the more prolonged the stops, the lower the actual miles traveled.
- During CPR, rescuers should deliver effective compressions at an appropriate rate (100 to 120/min) and depth while minimizing the number and duration of interruptions in chest compressions. Additional components of high-quality CPR include allowing complete chest recoil after each compression and avoiding excessive ventilation.

## Chest Compression Depth*

**2015 (Updated):** During manual CPR, rescuers should perform chest compressions to a depth of at least 2 inches (5 cm) for an average adult, while avoiding excessive chest compression depths (greater than 2.4 inches [6 cm]).

**2010 (Old):** The adult sternum should be depressed at least 2 inches (5 cm).

**Why:** Compressions create blood flow primarily by increasing intrathoracic pressure and directly compressing the heart, which in turn results in critical blood flow and oxygen delivery to the heart and brain. Rescuers often do not compress the chest deeply enough despite the recommendation to "push hard." While a compression depth of at least 2 inches (5 cm) is recommended, the 2015 Guidelines Update incorporates new evidence about the potential for an upper threshold of compression depth (greater than 2.4 inches [6 cm]), beyond which complications may occur. Compression depth may be difficult to judge without use of feedback devices, and identification of upper limits of compression depth may be challenging. It is important for rescuers to know that the recommendation about the upper limit of compression depth is based on 1 very small study that reported an association between excessive compression depth and injuries that were not life-threatening. Most monitoring via CPR feedback devices suggests that compressions are more often too shallow than they are too deep.

## Bystander Naloxone in Opioid-Associated Life-Threatening Emergencies*

**2015 (New):** For patients with known or suspected opioid addiction who are unresponsive with no normal breathing but a pulse, it is reasonable for appropriately trained lay rescuers and BLS providers, in addition to providing standard BLS care, to administer intramuscular (IM) or intranasal (IN) naloxone. Opioid overdose response education with or without naloxone distribution to persons at risk for opioid overdose in any setting may be considered. This topic is also addressed in the Special Circumstances of Resuscitation section.

**Why:** There is substantial epidemiologic data demonstrating the large burden of disease from lethal opioid overdoses, as well as some documented success in targeted national strategies for bystander-administered naloxone for people at risk. In 2014, the naloxone autoinjector was approved by the US Food and Drug Administration for use by lay rescuers and HCPs.[7] The resuscitation training network has requested information about the best way to incorporate such a device into the adult BLS guidelines and training. This recommendation incorporates the newly approved treatment.

# Adult Basic Life Support and CPR Quality: HCP BLS

## Summary of Key Issues and Major Changes

Key issues and major changes in the 2015 Guidelines Update recommendations for HCPs include the following:

- These recommendations allow flexibility for activation of the emergency response system to better match the HCP's clinical setting.
- Trained rescuers are encouraged to simultaneously perform some steps (ie, checking for breathing and pulse at the same time), in an effort to reduce the time to first chest compression.
- Integrated teams of highly trained rescuers may use a choreographed approach that accomplishes multiple steps and assessments simultaneously rather than the sequential manner used by individual rescuers (eg, one rescuer activates the emergency response system while another begins chest compressions, a third either provides ventilation or retrieves the bag-mask device for rescue breaths, and a fourth retrieves and sets up a defibrillator).
- Increased emphasis has been placed on high-quality CPR using performance targets (compressions of adequate rate and depth, allowing complete chest recoil between compressions, minimizing interruptions in compressions, and avoiding excessive ventilation). See Table 1.
- Compression **rate** is modified to a range of 100 to 120/min.
- Compression **depth** for adults is modified to at least 2 inches (5 cm) but should not exceed 2.4 inches (6 cm).
- To allow full chest wall **recoil** after each compression, rescuers must avoid leaning on the chest between compressions.
- Criteria for **minimizing interruptions** is clarified with a goal of chest compression fraction as high as possible, with a target of at least 60%.
- Where EMS systems have adopted bundles of care involving continuous chest compressions, the use of passive ventilation techniques may be considered as part of that bundle for victims of OHCA.
- For patients with ongoing CPR and an advanced airway in place, a simplified ventilation rate of 1 breath every 6 seconds (10 breaths per minute) is recommended.

These changes are designed to simplify training for HCPs and to continue to emphasize the need to provide early and high-quality CPR for victims of cardiac arrest. More information about these changes follows.

> In the following topics for HCPs, an asterisk (*) marks those that are similar for HCPs and lay rescuers.

## Immediate Recognition and Activation of Emergency Response System

**2015 (Updated):** HCPs must call for nearby help upon finding the victim unresponsive, but it would be practical for an HCP to continue to assess the breathing and pulse simultaneously before fully activating the emergency response system (or calling for backup).

**2010 (Old):** The HCP should check for response while looking at the patient to determine if breathing is absent or not normal.

**Why:** The intent of the recommendation change is to minimize delay and to encourage fast, efficient simultaneous assessment and response, rather than a slow, methodical, step-by-step approach.

## Emphasis on Chest Compressions*

**2015 (Updated):** It is reasonable for HCPs to provide chest compressions and ventilation for all adult patients in cardiac arrest, whether from a cardiac or noncardiac cause. Moreover, it is realistic for HCPs to tailor the sequence of rescue actions to the most likely cause of arrest.

**2010 (Old):** It is reasonable for both EMS and in-hospital professional rescuers to provide chest compressions and rescue breaths for cardiac arrest victims.

**Table 1** BLS Dos and Don'ts of Adult High-Quality CPR

| Rescuers Should | Rescuers Should *Not* |
|---|---|
| Perform chest compressions at a rate of 100-120/min | Compress at a rate slower than 100/min or faster than 120/min |
| Compress to a depth of at least 2 inches (5 cm) | Compress to a depth of less than 2 inches (5 cm) or greater than 2.4 inches (6 cm) |
| Allow full recoil after each compression | Lean on the chest between compressions |
| Minimize pauses in compressions | Interrupt compressions for greater than 10 seconds |
| Ventilate adequately (2 breaths after 30 compressions, each breath delivered over 1 second, each causing chest rise) | Provide excessive ventilation (ie, too many breaths or breaths with excessive force) |

**Table 3** Core AHA ECC Educational Concepts

| | |
|---|---|
| **Simplification** | Course content should be simplified in both the presentation of the content and the breadth of content to facilitate accomplishment of course objectives.[10,11] |
| **Consistency** | Course content and skill demonstrations should be presented in a consistent manner. Video-mediated, practice-while-watching instruction is the preferred method for basic psychomotor skill training because it reduces instructor variability that deviates from the intended course agenda.[11-14] |
| **Contextual** | Adult learning principles[15] should be applied to all ECC courses, with emphasis on creating relevant training scenarios that can be applied practically to the learners' real-world setting, such as having hospital-based learners practice CPR on a bed instead of the floor. |
| **Hands-on practice** | Substantial hands-on practice is needed to meet psychomotor and nontechnical/leadership skill performance objectives.[11,12,16-18] |
| **Practice to mastery** | Learners should have opportunities for repetitive performance of key skills coupled with rigorous assessment and informative feedback in a controlled setting.[19-22] This deliberate practice should be based on clearly defined objectives[23-25] and not time spent, to promote student development toward mastery.[26-30] |
| **Debriefing** | The provision of feedback and/or debriefing is a critical component of experiential learning.[31] Feedback and debriefing after skills practice and simulations allow learners (and groups of learners) the opportunity to reflect on their performance and to receive structured feedback on how to improve their performance in the future.[32] |
| **Assessment** | Assessment of learning in resuscitation courses serves to both ensure achievement of competence and provide the benchmarks that students will strive toward. Assessment also provides the basis for student feedback (assessment *for* learning). Assessment strategies should evaluate competence and promote learning. Learning objectives[33] must be clear and measurable and serve as the basis of evaluation. |
| **Course/program evaluation** | This is an integral component of resuscitation education, with the appraisal of resuscitation courses including learner, individual instructor, course, and program performance.[34] Training organizations should use this information to drive the continuous quality improvement process. |

Abbreviations: AHA, American Heart Association; CPR, cardiopulmonary resuscitation; ECC, emergency cardiovascular care.

## CPR Feedback Devices

**2015 (Updated):** Use of feedback devices can be effective in improving CPR performance during training.

**2015 (New):** If feedback devices are not available, auditory guidance (eg, metronome, music) may be considered to improve adherence to recommendations for chest compression rate.

**2010 (Old):** The use of a CPR feedback device can be effective for training.

**Why:** New evidence differentiates the benefit of different types of feedback for training, with a slight advantage given to feedback that is more comprehensive.

## Use of High-Fidelity Manikins

**2015 (Updated):** The use of high-fidelity manikins for advanced life support training can be beneficial for improving skills performance at course conclusion.

**2010 (Old):** Realistic manikins may be useful for integrating the knowledge, skills, and behaviors in advanced life support training.

**Why:** In the 2010 evidence review, there was insufficient evidence to recommend the routine use of more realistic manikins to improve skills performance in actual resuscitations, particularly given the additional costs and resources required. Considering both the potential benefit of having more realistic manikins as well as the increased costs and resources involved, newly published literature supports the use of high-fidelity manikins, particularly in programs where resources (eg, human and financial resources) are already in place.

## Blended Learning Formats

**2015 (Updated):** CPR self-instruction through video and/or computer-based modules with hands-on practice may be a reasonable alternative to instructor-led courses.

**2015 (New):** It may be reasonable to use alternative instructional modalities for basic and advanced life support teaching in resource-limited environments.

**2010 (Old):** Short video instruction combined with synchronous hands-on practice is an effective alternative to instructor-led BLS courses.

**Why:** Learner outcomes are more important than course formats. Knowledge and skill acquisition and retention and, ultimately, clinical performance and patient outcome should guide resuscitation education. There is new evidence that specific formats, such as CPR self-instruction using

video or computer-based modules, can provide similar outcomes to instructor-led courses. The ability to effectively use alternative course formats is particularly important in resource-limited environments where instructor-led courses may be cost prohibitive. Self-instruction courses offer the opportunity to train many more individuals to provide CPR while reducing the cost and resources required for training—important factors when considering the vast population of potential rescuers that should be trained.

## Targeted Training

**2015 (New):** Training primary caregivers and/or family members of high-risk patients may be reasonable.

**Why:** Studies consistently show high scores for CPR performance by trained family members and/or caregivers of high-risk cardiac patients as compared with those who were untrained.

## Expanded Training for AEDs

**2015 (Updated):** A combination of self-instruction and instructor-led teaching with hands-on training can be considered as an alternative to traditional instructor-led courses for lay providers. If instructor-led training is not available, self-directed training may be considered for lay providers learning AED skills.

**2015 (New):** Self-directed methods can be considered for healthcare professionals learning AED skills.

**2010 (Old):** Because even minimal training in AED use has been shown to improve performance in simulated cardiac arrests, training opportunities should be made available and promoted for lay rescuers.

**Why:** AEDs can be correctly operated without any prior training: There is no need for a requirement for training to be placed on the use of AEDs by the public. Nevertheless, even minimal training improves performance, timeliness, and efficacy. Self-directed training broadens the opportunities for training for both lay providers and healthcare professionals.

## Teamwork and Leadership

**2015 (Updated):** Given the very small risk for harm and the potential benefit of team and leadership training, the inclusion of team and leadership training as part of advanced life support training is reasonable.

**2010 (Old):** Teamwork and leadership skills training should be included in advanced life support courses.

**Why:** Resuscitation is a complex process that often involves the cooperation of many individuals. Teamwork and leadership are important components of effective resuscitation. Despite the importance of these factors, there is limited evidence that teamwork and leadership training affects patient outcomes.

## Compression-Only CPR

**2015 (New):** Communities may consider training bystanders in compression-only CPR for adult OHCA as an alternative to training in conventional CPR.

**Why:** Compression-only CPR is simpler for lay providers to learn than conventional CPR (compressions with breaths) and can even be coached by a dispatcher during an emergency. Studies performed after a statewide educational campaign for bystander compression-only CPR showed that the prevalence of both overall CPR and compression-only CPR by bystanders increased.

## BLS Retraining Intervals

**2015 (Updated):** Given the rapidity with which BLS skills decay after training, coupled with the observed improvement in skill and confidence among students who train more frequently, it may be reasonable for BLS retraining to be completed more frequently by individuals who are likely to encounter cardiac arrest.

**2015 (New):** Given the potential educational benefits of short, frequent retraining sessions coupled with the potential for cost savings from reduced training time and removal of staff from clinical environment for standard refresher training, it is reasonable that individuals who are likely to encounter a cardiac arrest victim perform more frequent manikin-based retraining. There is insufficient evidence to recommend the optimal time interval.

**2010 (Old):** Skill performance should be assessed during the 2-year certification with reinforcement provided as needed.

**Why:** While growing evidence continues to show that recertification in basic and advanced life support every 2 years is inadequate for most people, the optimal timing of retraining has not been determined. Factors that affect the optimal retraining interval include the quality of initial training, the fact that some skills may be more likely to decay than others, and the frequency with which skills are used in clinical practice. Although data are limited, there is an observed improvement in skills and confidence among students who train more frequently. Also, frequent refreshers with manikin-based simulation may provide cost savings by using less total retraining time as compared with standard retraining intervals.

# First Aid

The *2015 AHA and American Red Cross Guidelines Update for First Aid* reaffirms the goals of first aid: to reduce morbidity and mortality by alleviating suffering, preventing further illness or injury, and promoting recovery. The scope of first aid has been expanded. First aid can be initiated by anyone, in any situation, and includes self-care.

## Summary of Key Issues and Major Changes

- The use of stroke assessment systems can assist first aid providers with identifying signs and symptoms of stroke.
- While glucose tablets are preferred for care of mild hypoglycemia, they may not be readily available. In these cases, other forms of sugar found in common dietary products have been found to be acceptable alternatives to glucose tablets for diabetics with mild symptomatic hypoglycemia who are conscious and are able to swallow and to follow commands.

**Why:** The administration of aspirin significantly decreases mortality due to myocardial infarction, but there is no evidence to support the use of aspirin for undifferentiated chest pain. A reduction in mortality is also found when "early" administration of aspirin (ie, in the first few hours after onset of symptoms from myocardial infarction) is compared with "later" (ie, after hospital arrival) administration of aspirin for chest pain due to acute myocardial infarction. It remains unclear, however, whether first aid providers can recognize the signs and symptoms of myocardial infarction, and it is possible that use of aspirin for noncardiac causes of chest pain could cause harm. Although the dose and form of aspirin used for chest pain was not specifically reviewed by the ILCOR First Aid Task Force, the bioavailability of enteric-coated aspirin is similar to non–enteric-coated when chewed and swallowed.[36] Thus, there is no longer the restriction to use non–enteric-coated aspirin, as long as the aspirin is chewed before swallowing.

## Anaphylaxis

**2015 (Updated):** When a person with anaphylaxis does not respond to an initial dose of epinephrine, and arrival of advanced care will exceed 5 to 10 minutes, a repeat dose may be considered.

**2010 (Old):** In unusual circumstances, when advanced medical assistance is not available, a second dose of epinephrine may be given if symptoms of anaphylaxis persist.

**Why:** The 2010 Guidelines recommended that first aid providers assist with or administer (the victim's own) epinephrine to persons with symptoms of anaphylaxis. Evidence supports the need for a second dose of epinephrine for acute anaphylaxis in persons not responding to a first dose; the guidelines revision provides clarification as to the time frame for considering a second dose of epinephrine.

## Hemostatic Dressings

**2015 (Updated):** First aid providers may consider use of hemostatic dressings when standard bleeding control measures (with direct pressure with or without gauze or cloth dressing) are not effective for severe or life-threatening bleeding.

**2010 (Old):** Routine use (of hemostatic agents) in first aid cannot be recommended at this time because of significant variation in effectiveness by different agents and their potential for adverse effects, including tissue destruction with induction of a proembolic state and potential thermal injury.

**Why:** The application of firm, direct pressure to a wound is still considered the primary means for control of bleeding. When direct pressure fails to control severe or life-threatening bleeding, first aid providers who have specific training in their indications and use may consider a hemostatic dressing. Newer-generation hemostatic agent-impregnated dressings have been shown to cause fewer complications and adverse effects than older hemostatic agents, and are effective in providing hemostasis in up to 90% of subjects.

## Spinal Motion Restriction

**2015 (Updated):** With a growing body of evidence showing harm and no good evidence showing clear benefit, routine application of cervical collars by first aid providers is not recommended. A first aid provider who suspects a spinal injury should have the injured person remain as still as possible while awaiting arrival of EMS providers.

**2010 (Old):** First aid providers should not use immobilization devices because their benefit in first aid has not been proven and they may be harmful. Maintain spinal motion restriction by manually stabilizing the head so that motion of the head, neck, and spine is minimized.

**Why:** In the 2015 ILCOR systematic review of the use of cervical collars as a component of spinal motion restriction for blunt trauma, there was no evidence found to show a decrease in neurologic injury with the use of cervical collars. In fact, studies demonstrated actual or potential adverse effects such as increased intracranial pressure and airway compromise with use of a cervical collar. Proper technique for application of a cervical collar in high-risk individuals requires significant training and practice to be performed correctly. Application of cervical collars is not a first aid skill. The revision of this guideline reflects a change in recommendation class to Class III: Harm due to potential for adverse effects.

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