Part 1: Introduction

This publication presents the 2005 American Heart Association (AHA) guidelines for cardiopulmonary resuscitation (CPR) and emergency cardiovascular care (ECC). The guidelines are based on the evidence evaluation from the 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations, hosted by the American Heart Association in Dallas, Texas, January 23–30, 2005.[1] These guidelines supersede the *Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care*.[2]

As with all versions of the ECC guidelines published since 1974,[2–6] the *2005 AHA Guidelines for CPR and ECC* contain recommendations designed to improve survival from sudden cardiac arrest and acute life-threatening cardiopulmonary problems. These guidelines, however, differ from previous versions in several ways. First, they are based on the most extensive evidence review of CPR yet published.[1] Second, these guidelines were developed under a new structured and transparent process for ongoing disclosure and management of potential conflicts of interest. Third, the guidelines have been streamlined to reduce the amount of information that rescuers need to learn and remember and to clarify the most important skills that rescuers need to perform.

Evidence Evaluation Process

The evidence evaluation process that was the basis for these guidelines was accomplished in collaboration with the International Liaison Committee on Resuscitation (ILCOR),[1] an international consortium of representatives from many of the world's resuscitation councils. ILCOR was formed to systematically review resuscitation science and develop an evidence-based consensus to guide resuscitation practice worldwide. The evidence evaluation process for these guidelines was built on the international efforts that produced the *ECC Guidelines 2000*.[2]

To begin the process, ILCOR representatives established 6 task forces: basic life support, advanced life support, acute coronary syndromes, pediatric life support, neonatal life support, and an interdisciplinary task force to address overlapping topics such as education. The AHA established 2 additional task forces—on stroke and first aid. The 8 task forces identified topics requiring evidence evaluation. They formulated hypotheses on these topics, and the task forces appointed international experts as worksheet authors for each hypothesis.

The worksheet authors were asked to (1) search for and critically evaluate evidence on the hypothesis, (2) summarize the evidence review, and (3) draft treatment recommendations. They then completed worksheets that provided the format for a structured literature review (Table 1). The worksheet authors identified key research studies, recorded the levels of evidence (Table 2) of the studies, and drafted recommendations. When possible, two worksheet authors, one from the United States and one from outside the United States, were recruited to complete independent reviews of each topic. This process is described in detail in the *2005 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations*[1] and the accompanying editorial.[7]

A total of 281 worksheet authors completed 403 worksheets on 276 topics. To obtain feedback from the resuscitation science community, in December 2004 the worksheets and worksheet author conflict of interest disclosures were posted on the Internet at *http://www.C2005.org*. Journal advertisements and emails invited comment from healthcare professionals and the resuscitation community. The comments were then referred to the task forces and worksheet authors for consideration. Worksheets are available through *http://www.C2005.org*.

Expert reviews began in 2002, and individual topics were presented and discussed at 6 international meetings, culminating in the 2005 Consensus Conference. The evidence was presented, discussed, and debated, with task forces and resuscitation councils meeting daily to draft summaries. The consensus statements on the science of resuscitation developed at the conference were incorporated into the *ILCOR 2005 CPR Consensus,* published simultaneously in *Circulation* and *Resuscitation* in November 2005.[1]

Guidelines and Treatment Recommendations

During the evidence evaluation process the ILCOR task forces weighed the evidence and developed consensus statements on the interpretation of the scientific findings. If the task forces agreed on common treatment recommendations, the recommendations were included with the science statements in the *ILCOR 2005 CPR Consensus*.[1] The consensus document was designed to serve as the science foundation for the guidelines to be published by many ILCOR member councils in 2005–2006.

Classes of Recommendation

Following the 2005 Consensus Conference, AHA ECC experts adapted the ILCOR scientific statements and expanded the treatment recommendations to construct these new guidelines. In developing these guidelines, the ECC experts used a recommendation classification system that is consistent with that used by the American Heart Association–American College of Cardiology collaboration on evidence-based guidelines.

The classes of recommendation used in this document are listed in Table 3. These classes represent the integration of the

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TABLE 1. Steps in Evidence Integration

Integrate all evidence following these steps:

1. Perform literature review and record search terms and databases searched.
2. Select studies relevant to hypothesis.
3. Determine level of evidence based on methodology (see Table 2).
4. Perform critical appraisal *(poor to excellent).*
5. Integrate evidence into a science summary and possible treatment recommendation.

Experts must develop consensus based on scientific evidence. Steps used include:

Evidence evaluation and worksheet preparation by experts, plus

2005 Consensus Conference presentations and discussions

ILCOR Task Force discussions and development of 2005 International Consensus on CPR and ECC Science With Treatment Recommendations publication[1]

Review and discussions by AHA ECC Committee and Subcommittees with development of specific recommendations and algorithms with classes of recommendations

Final editorial review and approval by AHA ECC Committee and Subcommittees

Blinded peer review

Review and approval by AHA Science Advisory and Coordinating Committee

Publication

TABLE 2. Levels of Evidence

Evidence	Definition
Level 1	Randomized clinical trials or meta-analyses of multiple clinical trials with substantial treatment effects
Level 2	Randomized clinical trials with smaller or less significant treatment effects
Level 3	Prospective, controlled, nonrandomized cohort studies
Level 4	Historic, nonrandomized cohort or case-control studies
Level 5	Case series; patients compiled in serial fashion, control group lacking
Level 6	Animal studies or mechanical model studies
Level 7	Extrapolations from existing data collected for other purposes, theoretical analyses
Level 8	Rational conjecture (common sense); common practices accepted before evidence-based guidelines

weight of scientific evidence with contextual factors such as expert assessment of 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 risk 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.

Ideally all CPR and ECC recommendations should be based on large prospective randomized controlled clinical trials that find substantial treatment effects on long-term survival and carry a Class I or Class IIa label. In reality few clinical resuscitation trials have sufficient power to demonstrate an effect on intact survival to hospital discharge. As a result the experts were often confronted with the need to make recommendations on the basis of results from human trials that reported only intermediate outcomes, nonrandomized or retrospective observational studies, animal models, or extrapolations. Recommendations were generally labeled Class IIb when the evidence documented only short-term benefits from the therapy (eg, amiodarone for pulseless ventricular fibrillation 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 "we recommend."

Algorithms

The 12 AHA CPR and ECC algorithms contained in these guidelines highlight essential assessments and interventions recommended to treat cardiac arrest or a life-threatening condition. These algorithms have been developed using a template with specific box shapes and colors. Memorizing the box colors and shapes is not recommended, nor is it necessary for use of the algorithms. But in response to requests from the AHA training network and from clinicians, we briefly describe the template used.

Box shape distinguishes action boxes from assessment boxes. Boxes with square corners represent interventions or therapies (ie, actions); rose-colored boxes with round corners represent assessment steps that typically create a decision point in care.

TABLE 3. Applying Classification of Recommendations and Level of Evidence

Class I	Class IIa	Class IIb	Class III
Benefit>>>Risk	Benefit>>Risk	Benefit≥Risk	Risk≥Benefit
Procedure/treatment or diagnostic test/assessment should be performed/administered.	It is reasonable to perform procedure/administer treatment or perform diagnostic test/assessment.	Procedure/treatment or diagnostic test/assessment may be considered.	Procedure/treatment or diagnostic test/assessment should not be performed/administered. It is not helpful and may be harmful.

Class Indeterminate.

- Research just getting started
- Continuing area of research
- No recommendations until further research (eg, cannot recommend for or against)

Colors of the boxes distinguish types of actions. As noted above, the rose boxes indicate assessment steps. In general, treatments that involve electrical therapy or drugs are placed in blue boxes, and simple action steps are placed in tan boxes. In order to emphasize the fundamental importance of good basic CPR in all ECC algorithms, action steps involving support of airway, breathing, and circulation are placed in green boxes. In addition, all advanced cardiovascular life support (ACLS) and pediatric advanced life support (PALS) algorithms contain a green "reminder" box to assist the clinician in recalling helpful information, including fundamentals of CPR. The algorithm box color-coding is not absolute because some boxes contain combinations of several types of actions.

Three algorithms have unique features. In the basic life support (BLS) healthcare provider adult and pediatric algorithms, the actions that are completed by only healthcare providers are bordered with a dotted line. In the ACLS Tachycardia Algorithm, several boxes are printed with screening (the text contained in screened boxes appears lighter than regular text). These screened boxes include actions that are intended to be accomplished in the in-hospital setting or with expert consultation readily available. Information in non-screened boxes is intended to apply to the out-of-hospital or the in-hospital setting. In the ACLS Tachycardia Algorithm, to create visual separation between actions for wide-complex versus narrow-complex tachycardia, boxes containing therapy for wide-complex tachycardia are shadowed with yellow, and boxes with treatment for narrow-complex tachycardia are shadowed with blue.

Management of Conflict of Interest

The world's leading experts in resuscitation science have established their expertise by undertaking and publishing research and related scholarly work. Some investigators' activities are supported by industry, thereby creating the potential for conflicts of interest.[8,9] Grants and other support for scientific research, speaker fees, and honoraria can also create potential financial conflicts of interest. Nonfinancial conflicts of interest include in-kind support, intellectual collaboration or intellectual investment in personal ideas, and long-term research agendas in which investigators have invested a substantial amount of time.

To protect the objectivity and credibility of the evidence evaluation and consensus development process, the AHA ECC Conflict of Interest (COI) policy was revised before the 2005 Consensus Conference to ensure full disclosure and comprehensive management of potential conflicts. A process was developed for managing potential conflicts of interest during the evidence evaluation process and the 2005 Consensus Conference. Each speaker's COI statement was projected on a dedicated screen during every presentation, question, and discussion period. The COI policy is described in detail in an editorial in this supplement[10] and the corresponding editorial in the *ILCOR 2005 CPR Consensus*.[11] Potential conflicts of interest disclosed by the editors and science volunteers of this document are listed in this supplement (Appendix 4). Potential conflicts of interest disclosed by members of the ECC Committee and subcommittees who wrote and reviewed this document are listed online as a COI supplement (available through *http://www.C2005.org*). Worksheet authors' potential conflicts of interest are included on each worksheet, which can be accessed through *http://www.C2005.org*.

New Developments

The most significant changes in these guidelines were made to simplify CPR instruction and increase the number of chest compressions delivered per minute and reduce interruptions in chest compressions during CPR. Following are some of the most significant new recommendations in these guidelines:

- Elimination of lay rescuer assessment of signs of circulation before beginning chest compressions: the lay rescuer will be taught to begin chest compressions immediately after delivering 2 rescue breaths to the unresponsive victim who is not breathing (Parts 4 and 11).
- Simplification of instructions for rescue breaths: all breaths (whether delivered mouth-to-mouth, mouth-to-mask, bag-mask, or bag-to–advanced airway) should be given over 1 second with sufficient volume to achieve visible chest rise (Parts 4 and 11).
- Elimination of lay rescuer training in rescue breathing without chest compressions (Parts 4 and 11).
- Recommendation of a single (universal) compression-to-ventilation ratio of 30:2 for single rescuers of victims of all ages (except newborn infants). This recommendation is designed to simplify teaching and provide longer periods of uninterrupted chest compressions (Parts 4 and 11).
- Modification of the definition of "pediatric victim" to preadolescent (prepubescent) victim for application of pediatric BLS guidelines for healthcare providers (Parts 3 and 11), but no change to lay rescuer application of child CPR guidelines (1 to 8 years).
- Increased emphasis on the importance of chest compressions: rescuers will be taught to "push hard, push fast" (at a rate of 100 compressions per minute), allow complete chest recoil, and minimize interruptions in chest compressions (Parts 3, 4, and 11).
- Recommendation that Emergency Medical Services (EMS) providers may consider provision of about 5 cycles (or about 2 minutes) of CPR before defibrillation for unwitnessed arrest, particularly when the interval from the call to the EMS dispatcher to response at the scene is more than 4 to 5 minutes (Part 5).
- Recommendation for provision of about 5 cycles (or about 2 minutes) of CPR between rhythm checks during treatment of pulseless arrest (Parts 5, 7.2, and 12). Rescuers should not check the rhythm or a pulse immediately after shock delivery—they should immediately resume CPR, beginning with chest compressions, and should check the rhythm after 5 cycles (or about 2 minutes) of CPR.
- Recommendation that all rescue efforts, including insertion of an advanced airway (eg, endotracheal tube, esophageal-tracheal combitube [Combitube], or laryngeal mask airway [LMA]), administration of medications, and reassessment of the patient be performed in a way that minimizes

interruption of chest compressions. Recommendations for pulse checks are limited during the treatment of pulseless arrest (Parts 4, 5, 7.2, 11, and 12).

- Recommendation of only 1 shock followed immediately by CPR (beginning with chest compressions) instead of 3 stacked shocks for treatment of ventricular fibrillation/pulseless ventricular tachycardia: this change is based on the high first-shock success rate of new defibrillators and the knowledge that if the first shock fails, intervening chest compressions may improve oxygen and substrate delivery to the myocardium, making the subsequent shock more likely to result in defibrillation (Parts 5, 7.2, and 12).
- Increased emphasis on the importance of ventilation and de-emphasis on the importance of using high concentrations of oxygen for resuscitation of the newly born infant (Part 13).
- Reaffirmation that intravenous administration of fibrinolytics (tPA) to patients with acute ischemic stroke who meet the NINDS eligibility criteria can improve outcome. The tPA should be administered by physicians in the setting of a clearly defined protocol, a knowledgeable team, and institutional commitment to stroke care (Part 9).
- New first aid recommendations (Part 14).

For further information about these and other new developments in these guidelines, see the editorial "The Major Changes in the 2005 AHA Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care"[12] in this supplement and the guidelines sections noted.

The recommendations in the *2005 AHA Guidelines for CPR and ECC* confirm the safety and effectiveness of many approaches, acknowledge that other approaches may not be optimal, and recommend new treatments that have undergone evidence evaluation. *These new recommendations do not imply that care involving the use of earlier guidelines is unsafe.* In addition, it is important to note that these guidelines will not apply to all rescuers and all victims in all situations. The leader of a resuscitation attempt may need to adapt application of the guidelines to unique circumstances.

Future Directions

The most important determinant of survival from sudden cardiac arrest is the presence of a trained rescuer who is ready, willing, able, and equipped to act. Although hypothermia has recently been shown to improve survival to hospital discharge for selected victims of VF SCA,[13] most advanced life support techniques have failed to improve outcome from SCA[14] or have only been shown to improve short-term survival (eg, to hospital admission).[15,16] Any improvements resulting from advanced life support therapies are less substantial than the increases in survival rate reported from successful deployment of lay rescuer CPR and automated external defibrillation programs in the community.[17–21]

Thus, our greatest challenge continues to be the improvement of lay rescuer education. We must increase access to CPR education, increase effectiveness and efficiency of instruction, improve skills retention, and reduce barriers to action for basic and advanced life support providers.[22] Resuscitation programs must establish processes for continuous quality improvement to reduce time to CPR and shock delivery and to improve the quality of CPR provided.[23,24]

The AHA and collaborating organizations will use these guidelines as the basis for developing comprehensive training materials. Once the training materials are available, the most important step will be to get them into the hands of rescuers who will learn, remember, and perform CPR and ECC skills.

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