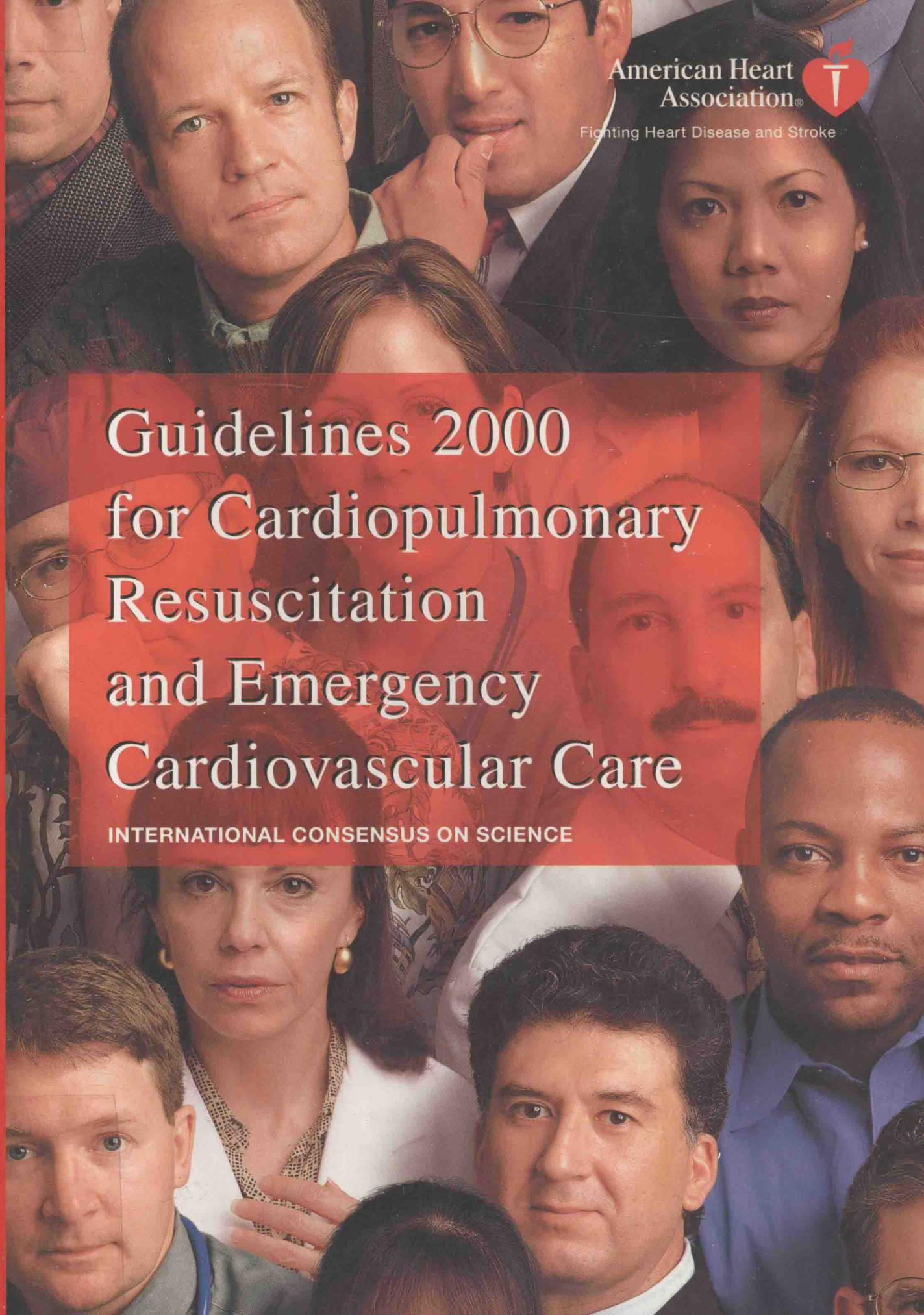

Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

INTERNATIONAL CONSENSUS ON SCIENCE

Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

An International Consensus on Science

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Editorials

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Part 1: Introduction to the International Guidelines 2000 for CPR and ECC

A Consensus on Science

International Guidelines

This publication presents the conclusions of the International Guidelines 2000 Conference on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC). We have achieved a long-term goal: to create valid, widely accepted international resuscitation guidelines based on international science and produced by international resuscitation experts. The Guidelines 2000 Conference was more than an update of previous recommendations for CPR and ECC published by the AHA (in 1974,[1] 1980,[2] 1986,[3] and 1992[4]) and similar recommendations published by the European Resuscitation Council (in 1992,[5] 1996,[6] and 1998[7]). The Guidelines 2000 Conference was the world's first international conference assembled specifically to produce international resuscitation guidelines.

At all stages of planning, coordination, and implementation, conference planners sought and achieved active involvement of individuals and councils outside the United States.

Important new recommendations were developed either at the 2000 conference or during the post-conference period of writing, review, and rewriting. Positive new additions had to pass our rigorous evidence-based review. Revisions of or deletions from existing guidelines occurred for any of 3 reasons: (1) lack of evidence to confirm effectiveness, (2) additional evidence to suggest harm or ineffectiveness, or (3) evidence that superior therapies have become available.

We have also produced the *International Consensus on Science: Proceedings of the 2000 Guidelines Conference on CPR and ECC*. The proceedings are detailed articles that recount the discussions and debates at the 2 conferences.

The International Guidelines 2000 represent a consensus of experts from a variety of countries, cultures, and disciplines. The conference experts, participants, and resuscitation councils do not dictate or impose these recommendations on any person, Emergency Medical Services (EMS) system, hospital, healthcare facility, community, state, country, or resuscitation council. The majority of the therapeutic interventions in the guidelines are "acts of medical practice." Most resuscitation personnel in the conference countries can use these interventions on a human being **only** when authorized by the "proper" local, state, or national agencies. Enforcement, authorization, and certification are medicolegal concepts with no role to play in the science-based International Guidelines 2000.

The recommendations of the Guidelines 2000 Conference confirm safety and effectiveness for many approaches, acknowledge ineffectiveness for others, and introduce new treatments that have survived intensive evidence-based evaluation. These new recommendations do not imply that care using past guidelines is either unsafe or ineffective. The conference participants consider these new guidelines to be the most effective and easily teachable guidelines that current knowledge, research, and experience can provide.

Historical Perspective

During the 40 years since the introduction of modern CPR and ECC there have been many advances in ECC for cardiac arrest victims. These interventions have restored the lives of many people when breathing has ceased and the heart has stopped. For those with preserved neurological function and treatable cardiopulmonary disease, a lengthy, vigorous, and high-quality life may often follow.

Until 1960 successful resuscitation was limited to victims of respiratory arrest. Emergency thoracotomy with "open-chest heart massage" was sometimes successful when proper personnel and equipment were readily available.[8] Termination of ventricular fibrillation by externally applied electricity was first described in 1956.[9] The ability of defibrillators to reverse a fatal arrhythmia was a dramatic achievement. Defibrillators challenged the medical community to develop ways to get the defibrillator to the patient's fibrillating heart as fast as possible while simultaneously sustaining ventilation and circulation. These challenges will continue into the next millenium.

In the 1950s Safar et al[10] and Elam et al[11] "rediscovered" mouth-to-mouth ventilation by reading how midwives used the technique to resuscitate newly born infants. In 1958 Safar et al confirmed the effectiveness of the mouth-to-mouth ventilation technique of Elam et al. In 1960 Kouwenhoven et al[12] observed that forceful chest compressions produced respectable arterial pulses. In a series consisting chiefly of anesthesia-induced cardiac arrests they confirmed that chest compressions alone could sustain life while awaiting more definitive care. The critical steps of modern CPR—"closed-chest" compressions and "mouth-to-mouth" ventilations—had arrived.[12]

Over the next several years, through casual conversations, Safar and Kouwenhoven saw the rationale for combining closed-chest compressions with mouth-to-mouth ventilations. Soon Safar confirmed the combined technique, now known as basic CPR. The simplicity of this technique has led to its

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TABLE 1. Milestones on the Way to International Guidelines 2000—The First International Conference on Guidelines for CPR and ECC

1966—First Conference on CPR: National Academy of Sciences, National Research Council	Recommended training medical, allied health, and other professional personnel in external chest compressions according to American Heart Association standards.[13,14]
1973—Second National Conference on CPR: American Heart Association, National Academy of Sciences, National Research Council	Recommended that CPR training programs be extended to the general public.
1979—Third National Conference on CPR: American Heart Association	Developed ACLS; recommendations for training, testing, and supervising medical and allied health personnel.
1983—First National Conference on Pediatric Resuscitation: American Academy of Pediatrics, American Heart Association	Developed guidelines for pediatric BLS and ALS, with separate guidelines for neonatal ALS.
1985—Fourth National Conference on CPR and ECC: American Heart Association, American Academy of Pediatrics	Reviewed experimental and clinical research published since the 1979 conference.
1992—Fifth National Conference on CPR and ECC: American Heart Association plus collaborating Councils. First meeting of ILCOR	Reviewed developments over the previous 7 years. These required review and resolution of disputes and disagreements. ILCOR founded; began 2 meetings a year until 2000.
2000—The First International Guidelines Conference on CPR and ECC: International Collaboration of AHA, ERC, HSFC, RCSA, ARC, CLAR, and others	First conference that was international in planning, topics, experts, writing, review, and publication. First to be evidence-based; used new class of recommendations.

ARC indicates Australian Resuscitation Council; CLAR, Resuscitation Councils of Latin America; ERC, European Resuscitation Council; HSFC, Heart and Stroke Foundation of Canada; RCSA, Resuscitation Councils of Southern Africa.

widespread dissemination: "All that is needed is 2 hands." The technique gives hope for reducing the nearly 1000 sudden deaths (on average) that occur each day, both in the United States and also in the whole of Europe, before patients reach the hospital.

Achievements and Recommendations from Previous Guideline Conferences

The Guidelines 2000 Conference must not be considered an American conference or an AHA conference. The most valid descriptive term is *international.* This conference, planned and organized by a liaison of the world's major resuscitation councils, embraced a wide range of topics and issues. Each previous conference also established important milestones (Table 1).

Beginning with the original 1966 conference of the National Academy of Sciences–National Research Council, every AHA conference has invited numerous international experts as well as delegates from international resuscitation councils. International intellectual exchange was pervasive, and all perspectives benefited from the exchange. Whether we think of ourselves as AHA delegates or European Resuscitation Council delegates matters nothing. We are now the World's Resuscitation Council; we hold a sobering responsibility to rise above national pride and self-interest and work together to achieve our simple goal—to reduce morbidity and mortality from cardiovascular and cardiopulmonary disease. Table 1 summarizes the important work that paved the way for modern CPR and ECC. The scientists, clinicians, experts, leaders, managers, and instructors who planned, developed, and conducted these conferences deserve our thanks and gratitude. We are in debt to their creativity, industry, and hard work.

Scientific Advances: ILCOR, Stroke, Acute Coronary Syndromes, and Public Access Defibrillation

Resuscitation is an active and exciting area of research. By 1997 ECC leaders recognized the need to incorporate new scientific advances into international guidelines in a timely fashion. The member councils of the International Liaison Committee on Resuscitation (ILCOR) provided strong support for this idea. As an international "council of councils," ILCOR embarked on a 2-year plan to develop a series of "advisory statements." These statements pursued 2 objectives: to identify all differences and inconsistencies among existing guideline publications and to conduct evidence-based review of resuscitation topics and advise the liaison councils on topics to revise, delete, or insert. ILCOR has published these advisory statements in *Circulation* and *Resuscitation.*

Rapid change occurred in the management of acute ischemic stroke and acute coronary syndromes between 1992 and 1997. In collaboration with other societies, a Stroke Task Force plus an Acute Coronary Syndrome Working Group developed interim guidelines. These guidelines have appeared in the 1995, 1997, 1999, and 2000 ECC handbooks.

New guidelines for the lay-responder's use of automated external defibrillators (AEDs) were developed following 2 national conferences on public access defibrillation (PAD).[15] This led directly to the development of the Heartsaver AED program, which provides a 3- to 4-hour course in both CPR and the use of an AED. The course is addressed to lay rescuers and first responders in the community.[16]

2000—The First International Conference on Guidelines for CPR and ECC

The objectives of the Guidelines 2000 Conference were to

1. Fulfill the 1992 goal of producing the first (a) international guidelines (b) supported by international science and (c) developed by international collaboration. A related goal was to have >50% of the conference participants affiliated with non-US organizations.
2. Establish ILCOR as the committee responsible for coordinating the international science review and communicating the international science conclusions via the recurring ILCOR advisory statements.

3. Confirm our strong commitment to these goals by requiring numerical equality—AHA versus non-US councils—on all guideline panels, topic discussions, summary presentations, moderator positions, panel experts, writers, summary presenters, and members of editorial boards.
4. Draft a consensus document that explained evidence-based guidelines development and evaluate the success or failure of evidence-based guidelines development. The draft consensus document was evaluated formally multiple times with appropriate revisions and modifications after each evaluation:
   - Mini-Evidence Evaluation Conference, March 1999
   - 2000 Evidence Evaluation Conference, September 1999
   - Guidelines 2000 Conference, February 2000
5. Review and revise recommendations from past conferences, based on scientific evidence that had accumulated since the previous guidelines. Develop guidelines for first aid at home and at the work site.
6. Review and recommend changes in the methods recommended for teaching the knowledge and skills of ECC, basic life support (BLS), pediatric advanced life support (PALS), and advanced cardiovascular life support (ACLS) in education and evaluation.

Evidence-Based Resuscitation Guidelines

Conference participants used evidence-based criteria to identify, evaluate, and appraise scientific publications and to propose needed changes. We supplied all experts, panel members, and attendees with a Worksheet for Proposed Evidence-Based Guidelines with step-by-step directions (these materials are available on the AHA website at http://www.americanheart.org/ECC/index.html). To increase the validity of the results obtained by this evidence-based approach, conference leaders requested help from topic experts, panel members, and members of the ECC Committee and the International Editorial Board. These reviews checked all changes and new interventions, not just for scientific accuracy, but also for possible future effects on *safety*, *cost*, *effectiveness*, and *teachability*.

All resuscitation councils and experts that participated in the Guidelines 2000 Conference applied the tools and principles of evidence-based medicine on all proposed guidelines:

1. Search for evidence: yield is a series of individual studies/publications
2. Determine the *level* of each piece of evidence (a single study's methodology) (see Table 2)
3. Critically *appraise* the quality of each article
4. Integrate all the acceptable evidence into a final *class of recommendation*.

Tables 2, 3, and 4 define the steps and terms used for this process.

The Effectiveness of ECC

Emergency Cardiovascular Care Defined

ECC includes all responses necessary to deal with sudden and often life-threatening events affecting the cardiovascular, cerebrovascular, and pulmonary systems. ECC specifically includes

1. Recognition of early warning signs of heart attack and stroke, efforts to prevent complications, reassurance of the victim, and prompt availability of monitoring equipment
2. Provision of immediate BLS at the scene when needed
3. Provision of ACLS at the scene as quickly as possible to defibrillate if necessary and stabilize the victim before transportation
4. Transfer of the stabilized victim to a hospital where definitive cardiac care can be provided

The most important link in the ECC system in the community is the layperson. Successful ECC depends on laypersons' understanding of the importance of early activation of the EMS system, their willingness and ability to initiate effective CPR promptly, and their training in and safe use of AEDs. Accordingly, providing lifesaving BLS at this level can be considered primarily a public, community responsibility.

ACLS includes the use of adjunctive equipment in supporting ventilation, the establishment of intravenous access, the administration of drugs, cardiac monitoring, defibrillation or other control of arrhythmias, and care after resuscitation. In virtually every EMS system in the world a medical physician must be involved to supervise and direct ACLS efforts (1) in person at the scene, (2) by direct voice communication, or (3) by the widely used mechanism of "standing orders." These are a set of written, condition-specific orders that instruct the nonphysician responders.

The Chain of Survival

The highest potential survival rate from cardiac arrest can be achieved only when the following sequence of events occurs as rapidly as possible: (1) recognition of early warning signs, (2) activation of the EMS system, (3) basic CPR, (4) defibrillation, (5) management of the airway and ventilation, and (6) intravenous administration of medications.[17] These events are indispensable for any success of the ECC endeavor. They have been likened to links in a chain. If any link is weak or missing, the chance of survival is lessened, and the EMS system is condemned to poor results. The links in the adult Chain of Survival are (1) early access, (2) early CPR, (3) early defibrillation, and (4) early ACLS.

Effectiveness of the Chain of Survival

Cost-effectiveness studies relate money expended to lives saved.[18–24] ECC-CPR leaders have asked questions about the proven effectiveness of the Chain of Survival and the separate links in the Chain. Is there a positive balance between the outcomes from adding new drugs or medical devices and the costs to obtain the new interventions?[25,26]

Our Most Effective Intervention: Defibrillation

Defibrillation, as an intervention, can be analyzed as a balance between costs expended and the clinical outcome. One study examined how many person-years of life would be added to a community if firefighters not currently providing any emergency medical care were trained to do CPR and defibrillation.[21] Another model estimated how many years of *quality-adjusted* person-years of life would be gained by decreasing time to defibrillation by 1 minute with a new PAD program.[22] If PAD is implemented with lay responders, the

TABLE 2. Levels of Evidence

Evidence Level	Definition
1. Positive RCTs ($P<0.05$)	A prospective RCT. Conclusions: new treatment significantly better (or worse) than control treatment.
2. Neutral RCTs (NS)	An RCT. Conclusions: new treatment no better than control treatment.
3. Prospective, nonrandom	Nonrandomized, *prospective* observational study of a group that uses new treatment; *must* have a control group for comparisons.
4. Retrospective, nonrandom	Nonrandomized, *retrospective* observational study; 1 group used new treatment; must have a control group for comparisons.
5. Case series	Series of patients received new treatment in past or will receive in future; watch to see what outcomes occur; no control group.
6. Animal studies (A and B)	Studies using animals or mechanical models; A-level animal studies are higher quality than B-level studies.
7. Extrapolations	Reasonable extrapolations from existing data or data gathered for other purposes; quasi-experimental designs.
8. Rational conjecture, common sense	Fits with common sense; has face validity; applies to many non–evidence-based guidelines that "made sense." No evidence of harm.

RCT indicates randomized, controlled trial.

program costs 1.5 times more per added quality-adjusted life-year than if implemented with police.

Decision analysis was used recently to assess the effectiveness of decreasing time to defibrillation by adding an early defibrillation program to the gaming casinos of Las Vegas, Nevada (USA). The program enrolled casino security guards and trained and equipped them to respond within 2 to 4 minutes to any arrest in the facility.[23] This early defibrillation program published the lowest cost per year of added life of any published out-of-hospital care program.

Decreasing time to defibrillation appears most cost-effective when a low-intensity intervention is used, such as police or lay responder defibrillation. Currently adding more professional responders to an existing EMS system to decrease the collapse-to-first-shock interval is economically unattractive.

Advanced Life Support

Studies that have evaluated the cost of ACLS for out-of-hospital sudden cardiac arrest have been severely limited. The best methodology, using the most comprehensive costing methods, confirmed the value of decreasing time to defibrillation by implementing early defibrillation in gaming establishments.

TABLE 3. Steps to Follow for Evidence Integration

Integrate all evidence following these steps:

1. Determine **level of evidence** based on methodology (as in Table 2)
2. Perform **critical appraisal** *(poor to excellent)*
3. Integrate all evidence into a final **class of recommendation** (see Table 4). Experts must distill many articles, at different evidence levels, at different quality levels, into one class of recommendation. Steps used include

   Consensus discussions by experts, plus

   1999 Evidence Evaluation Conference discussions, plus

   Guidelines 2000 Conference input, plus

   Final editorial review by *International Editorial Board, Science Product Development Panel, ECC Committees and Subcommittees*

The goal of CPR-ECC programs is to increase the number of lives saved by prevention, risk factor modification, and emergency intervention at comparatively little cost.[27] Improving the efficacy of emergency cardiovascular intervention for victims of cardiopulmonary arrest requires aggressive implementation strategies.

Cardiopulmonary-Cerebral Resuscitation

Although the importance of CPR and BLS is undisputed, the efficacy of CPR in prolonged arrest is modest at best. When CPR and defibrillation are delayed or when definitive care is not closely followed, the Chain of Survival is broken. The cerebral cortex, the tissue most susceptible to hypoxia, is irreversibly damaged, resulting in death or severe neurological damage. The need to preserve cerebral viability must be stressed both in research endeavors and in practical interventions. The term *cardiopulmonary-cerebral resuscitation* has been used to further emphasize this need.[28,29]

The initial hope for closed-chest CPR was that circulation and oxygenation could maintain viability long enough to bring the defibrillator to the victim's aid.[12] BLS is often successful if defibrillation (and other modes of definitive care) occurs sooner than 8 to 10 minutes after collapse.[30–32] If restoration of spontaneous circulation occurs after the 8- to 10-minute limit, the frequency of significant, permanent neurological damage becomes unacceptably high. Responding and shocking as fast as possible, seldom exceeding 8 to 10 minutes, is a central objective of all EMS systems. In many communities it rarely happens.

The Hope of Public Access Defibrillation

By the mid and late 1990s great optimism arose because of reports of success from early PAD-like programs. PAD programs stay within the limit of 8 to 10 minutes, and can even decrease the response interval to as little as 3 to 5 minutes.[33–40] These and other preliminary data from PAD programs confirm epidemiological observations that every minute increment from the time of collapse to defibrillation will result in a substantial decrease in survival. This objective

TABLE 4. Classes of Recommendations 2000: Classification of Therapeutic Interventions in CPR and ECC

1. Search for Evidence: Locates the Following	2. Consensus Review by Experts: Intervention Is Placed in Following Class	3. Interpretation of This Class of Recommendation When Used Clinically
Minimum evidence required for a Class I recommendation • Level of evidence: 1 or more RCTs • Critical assessment: *excellent* • Results: homogeneous, consistently positive, and robust	***Class I: Excellent*** *Definitely recommended* Supported by ***excellent*** evidence Proven efficacy and effectiveness	**Class I** interventions are always acceptable, proven safe, and definitely useful.
Minimum evidence required for a Class IIa recommendation • Level of evidence: higher • Number of studies: multiple • Critical assessment: *good to very good* • Weight of evidence/expert opinion: more strongly in favor of intervention than Class IIb • More long-term outcomes measured than Class IIb • Results: positive in majority of studies • Observed magnitude of benefit: higher than Class IIb • Results: positive in majority of studies • Observed magnitude of benefit: higher than Class IIb	***Class IIa: Good to very good*** *Acceptable and useful* ***Good/very good*** evidence provides support Note*: "Contextual" factors: In addition to level of evidence, these additional factors are considered in making final class of recommendation. Contextual factors include small magnitude of benefit, high cost, educational and training challenges, large difficulties in implementation, and impractical, unfavorable cost-benefit ratios.	**Class IIa** interventions are acceptable, safe, and useful. • Considered standard of care: reasonably prudent physicians can choose • Considered ***intervention of choice*** by majority of experts • Often receive AHA support in training programs, teaching materials, etc *"Contextual" or "mismatch" factors may render an intervention Class IIa in one context and Class IIb in another (see Note*).*
Minimum evidence required for a Class IIb recommendation • Level of evidence: lower/intermediate • Number of studies: few • Critical assessment: *fair or poor* • Weight of evidence/expert opinion: less in favor of usefulness/efficacy • Outcomes measured: immediate, intermediate, or surrogate • Results: generally, not always, positive	***Class IIb: Fair to good*** *Acceptable and useful* ***Fair to good*** evidence provides support. Note: Contextual/mismatch factors should not be used to avoid the trouble and expense of adopting new but clinically beneficial interventions.	**Class IIb** interventions are acceptable, safe, and useful. • Considered within "standard of care": reasonably prudent physicians can choose • Considered *optional* or *alternative interventions* by majority of experts
Evidence found but available studies have one or more shortcomings • Promising but low level • Fail to address relevant clinical outcomes • Are inconsistent, noncompelling, or report contradictory results • May be high level but report conflicting results	***Class Indeterminate*** *Preliminary research stage* Available evidence insufficient to support a final class decision Results promising but need additional confirmation Evidence: no harm, but no benefit No recommendation until further evidence is available.	Note: Interventions classed ***Indeterminate*** can still be recommended for use, but reviewers must acknowledge that research quantity/quality fall short of supporting a final class decision. Do not use *Indeterminate* to resolve debates among experts, especially when evidence is available but experts disagree on interpretation. *Indeterminate* is limited to promising interventions.
Positive evidence completely absent *or* **Evidence strongly suggests or confirms harm**	***Class III: Unacceptable, no documented benefit, may be harmful*** *Not acceptable, not useful, may be harmful*	Interventions are designated as Class III when evidence of benefit is completely lacking or studies suggest or confirm harm.

RCT indicates randomized, controlled trial.

of earlier defibrillation has been attained in multiple PAD venues, including police, first responders, airports, and commercial airline flights. These researchers also reported substantial increases in the frequency of neurologically intact survivors.

With reported survival rates of up to 49%, PAD has the potential to be the single greatest advance in the treatment of prehospital sudden cardiac death since the invention of CPR.

The Preventive Cardiology–CPR Paradox

Fully 50% of men and women in western society with serious coronary artery disease (CAD) experience their first signs of the disease in a dramatic way—sudden cardiac arrest. This statement may apply to women as well, but no study has examined this issue in women. The first sign of progressive narrowing of the coronary arteries from the decades-long buildup of intra-arterial plaque can be a rapid sequence of sudden plaque rupture or erosion, platelet adhesion, and an

occluding thrombus. The arterial obstruction leads to severe ischemia, an irritable myocardium, and sudden generation of ventricular fibrillation, collapse, and death. Whether a victim lives or dies at this point depends on whether the collapse is witnessed; whether the people who respond are trained in CPR, resuscitation, and defibrillation; and whether they work within an emergency response system that can bring about early arrival of BLS and ACLS resources.

The "Risk Factors Modification and Prevention Message" for Preventive Cardiology.

The following statements are modified from the 1992 *Guidelines for CPR and ECC*, pages 2175–2176.

1. Cardiac arrest and MI are, in the vast majority of cases, end points in the evolution of atherosclerotic arterial disease over a period of decades.
2. The rate of progression of atherosclerosis is the primary determinant of the age at which MI and sudden death occur.
3. The rate of progression can be significantly influenced by specific conditions and behaviors referred to as *risk factors.*
4. Control or elimination of risk factors can be achieved by establishing positive health attitudes and behaviors in the young.
5. Modification of cardiovascular risk factors in adults, even in those who have had an MI, can alter the rate of progression of arterial disease and reduce the incidence of major end points, ie, sudden death, MI, and stroke.
6. Effective strategies to delay death due to cardiovascular disease include primary, secondary, and tertiary prevention and therapy.
7. Significant modifications in risk factors can occur by exercise; cessation of smoking; dietary modification; treatment and control of hypertension; and use of statin agents, anticoagulants, antiplatelet agents, angiotensin-converting enzyme inhibitors, as well as aspirin and β-blockers.
8. Effective strategies to delay death after successful treatment of sudden cardiac arrest include use of amiodarone or implantable cardioverter-defibrillators.

The perspective of preventive cardiology is to point out the strange paradox of investing so much time and so many resources into an EMS response when such a death would have been so easy to prevent or at least delay through the principles of preventive cardiology.

The sidebar reprints statements endorsed by the 1992 Guidelines Conference. The elimination of most of this material from lay and healthcare provider CPR training implies no disagreement with these concepts and recommendations. Neither does this imply rejection of the concept that prevention is the best way to reduce the heavy toll of premature morbidity and mortality from heart disease and stroke.

The goals of teaching the community to function as a prevention intervention and as the ultimate coronary care unit are as follows:

1. Adoption of healthy heart living at the earliest age possible, focusing on diet and preventive screening before any development of a disease process (primary prevention)
2. Recognition and reduction of reversible risk factors among the population free of clinical manifestations of CAD, especially among the young (secondary prevention)
3. Recognition and reduction of reversible risk factors among the population in which disease is progressing and clinical manifestations of CAD are beginning (tertiary prevention)
4. A lay public able to recognize the symptoms of a possible MI and educated to seek prompt entry of the victim into the EMS system
5. A lay public educated in the importance of early BLS and ACLS and eager to support an effective EMS system in the community
6. A lay public able to support the life of the cardiac arrest victim until ACLS becomes available

Final Comments: Have We Achieved "International Guidelines" at the Guidelines 2000 Conference on CPR and ECC?

The authors named the *International Guidelines 2000 Conference* appropriately. Participants from outside the United States comprised 40% of the total number of people attending. Planning for the new international guidelines included concerted efforts to have international representation at all stages. The Conference did achieve equality in terms of the important roles of primary reviewers and writers, topic experts, and panel moderators. At least 1 US scientist and 1 non-US scientist evaluated each topic.

During the *Guidelines 2000 Conference* the ECC Committee delegated final review of the guidelines to the existing *AHA Scientific Product Development Panel.* This Panel comprises the chairs of the ECC subcommittees, the panel of Science Editors (1 or 2 for each subcommittee), and the 2 Senior Science Editors. The ILCOR and other international delegates appointed an International Editorial Board.

Resource staff posted drafts of the guidelines on a secure website accessible to the 2 editorial groups for review and comment. Most scientific issues had been resolved by the end of the conference.

Some issues did arise as a product of the international nature of this process. Most occurred during the months of postconference writing and review. The scientific infrastructure, the debates and discussions, and the final recommendations were close to identical for all of the participating organizations. Some differences, however, remained. Thematically these issues grew out of preexisting international differences in law, ethics, system management, and local regulations. Scientific issues were virtually nonexistent.

Resuscitation councils must confront geographic and economic differences in the availability of medical devices and pharmacological agents. Each resuscitation council struggles with international differences in instructional methods, teaching aids, and training networks. The world's resuscitation councils must develop organized plans to support instruction

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in the new guidelines to citizen responders, BLS providers, and advanced healthcare professionals.

The worldwide distribution of these guidelines will be enhanced by publication in an official journal of the AHA, *Circulation*, and the official journal of the European Resuscitation Council, *Resuscitation. Circulation* and *Resuscitation* will publish the International Guidelines 2000 as a statement that strongly merits the description "international." Publication of the guidelines is the product of these councils:

- American Heart Association
- Australian Resuscitation Council
- European Resuscitation Council
- Heart and Stroke Foundation of Canada
- New Zealand Resuscitation Council
- Resuscitation Councils of Latin America
- Resuscitation Councils of Southern Africa

Appendix: Educational and Training Issues in ECC and CPR—Experiences and Plans of the AHA

Editors' Note: Throughout the process of writing the International Guidelines 2000 the Senior Science Editors and the Editorial Board have attempted to create a work that is *geopolitically neutral.* Guidelines dominated by the perspectives of 1 country or 1 resuscitation council would be unacceptable.

This Appendix breaches this objective of geopolitical neutrality. This discussion of educational and training issues depicts the experiences of the AHA. In addition to being actively involved in resuscitation research, the AHA is responsible for an immense infrastructure supporting resuscitation training and education across the United States. The experiences of the AHA have accumulated for more than a quarter century. We have learned from both our mistakes and our successes. We share these experiences with you with the hope that they will facilitate development and improvement of ECC programs in your community. —R.O.C. and M.F.H.

Long-Term View of CPR Training

Training in CPR has been recommended for healthcare professionals for more than 3 decades[13,14] and for the lay public since 1974.[1] These recommendations have resulted in the development of a wide variety of BLS programs sponsored by ECC organizations around the world. In most programs BLS instructors are trained by the sponsoring organization to deliver information, to teach skills, and to evaluate the knowledge and skills of those they teach.[41–43] This type of training relies on a traditional course format of lecture, skills demonstrations, skills practice, and evaluation using detailed skills performance checklists. In essence such courses are "instructor centered" because the instructor is free to organize the course as he or she desires, including deciding how much time to devote to lectures, demonstrations, and practice; how to communicate the information; and how to evaluate the knowledge and performance of each student. Courses cover numerous topics, including anatomy and physiology, recognition of heart attack and stroke, actions to increase survival, risk factors for heart disease and stroke, lifestyle behaviors, recognition of foreign-body airway obstruction (FBAO), and the skills of rescue breathing, CPR, and relief of FBAO. This material is typically covered in a 4- to 8-hour course.[44] The amount of time for each specific unit of the course often is not defined, which allows the instructor to choose which units should be emphasized and how information should be distributed.

Numerous studies have evaluated this type of program for instructor performance,[45] postcourse skills performance,[46] and retention 3 months, 6 months, and 1 year after training.[47–51] Most studies have documented poor postcourse performance and poor retention of core BLS skills. This educational failure has been attributed to multiple factors, including insufficient practice time, the complexity and large amount of information covered, and numerous other factors across the educational spectrum. One study showed that instructors tend to spend too much time lecturing and allow too little time for practice. In addition, instructors provided poor feedback and correction of skills and did not follow the prescribed curriculum.[45] The quality and accuracy of skills evaluation by instructors has also been questioned. Studies have noted poor interinstructor reliability during skills evaluation even when standardized checklists were used.[52,53] Use of manikins with tape readouts in conjunction with instructor observation and computerized feedback with instructor observation have been shown to be the most objective and accurate forms of evaluation, but these methods were criticized as a cause of "strict constructionist" behavior in the classroom. Instructors tended to expect an unrealistic skill level during evaluation, which in turn led to excessive criticism and negative feedback to students. Beginning in the early 1990s, instructors and trainers started to reshape CPR training by developing simpler skills checklists and equipment manufacturers simplified the design of manikins.

In addition, studies have shown that participants are frequently reluctant to perform CPR even after they are trained.[54] This reluctance is related to such concerns as anxiety, guilt, fear of imperfect performance, responsibility, and infection. These issues must be addressed during the CPR course to alleviate participants' concerns.

Numerous innovative instructional methods have been used to improve performance. These include overtraining,[55] simplification of course content, videotaped instruction for initial learning and reinforcement,[56–58] videotaped self-instruction with manikins,[59–61] use of "practice-after-watching" videotapes with instructor support,[16] and use of audio prompts.[62–64]

Simplification

There is now widespread consensus that BLS training needs to be simplified so that students can focus on learning the essential skills of CPR. Skills performance sheets have been revised to reduce the number of critical steps needed to successfully perform CPR. The complexity of the sequences and the precision required to perform them contribute to widespread learning difficulties. No evidence supports rigorous training requirements as a way to improve outcomes. Simplification of the educational content of materials will improve learning and retention in both basic and advanced ECC programs. A comparison of video self-instruction and traditional CPR training revealed that students who watched a 34-minute video focusing on a single task (1-rescuer adult CPR) retained more information and skills than students taught in a 4-hour course covering numerous topics.[59] Audio prompts and home learning systems have also been used successfully to simplify CPR education.[63,64]

In 1 study, reducing the number of steps in CPR from 8 steps to 4 resulted in superior skills retention. Shorter, objective-focused ACLS courses do a better job at teaching core skills and improving retention than long courses do.[65] Peer training provides a mechanism for training large numbers of people in a cost-effective manner. Simplification of the design of peer-training courses has significantly improved learning and retention.[66]

Use of core objectives to determine the essential content of a course may be a helpful method for focusing on the essential information needed for a target audience. Table 5 describes the core objectives of BLS and thus the core content of BLS courses defined in a recent consensus process.

Future research should focus on controlled trials of simplified action sequences and skills in ECC courses. Outcome studies should be performed to verify proficiency when new, simpler sequences and skills are used, and clinical studies should be conducted if there are significant changes in resuscitation sequences or procedures.

Targeting Populations for CPR Education

Target: Family Members of High-Risk Cardiac Patients

Past CPR guidelines recommended aiming courses at relatives and close friends of persons at risk.[67] The International Guidelines 2000 also recommend that the public be taught both adult and pediatric BLS on the basis of individual need for CPR training. In particular, pediatric BLS training is recommended for caretakers of children, including parents, teachers, baby-sitters, daycare workers, and in some cases siblings.

Scientific evaluations support establishment of priority groups to guide CPR education, training, practice, and research. Several studies[68–70] have shown that family members of high-risk populations benefit from learning CPR. Research confirms that tailoring CPR education to family members results in positive attitudes toward learning and implementing CPR.[68,70,71] Many family members of high-risk patients learn CPR successfully without deleterious psychosocial consequences,[69] yet they are less likely to seek CPR training and least likely actually to receive CPR training. We must continue to aim CPR courses at family members of high-risk patients.

On the basis of evidence presented at the international Guidelines 2000 Conference, we recommend that strong recruitment efforts be directed at

- Families and caregivers of infants and children at risk for life-threatening events
- Families and caregivers of adults at risk for sudden cardiac events, especially elderly couples

After thorough discussion this was made a Class IIa recommendation.

Additional studies are needed (1) to determine which individual characteristics of courses lead to increased participation in CPR training, (2) to describe the factors that prevent healthcare professionals from recommending CPR training to families of at-risk patients, and (3) to identify the CPR training methods that are most attractive to families and caretakers of at-risk patients.

A New Era? Video-Mediated Instruction

Video self-instruction, like many other learning methods, is effective in teaching the initial cognitive and psychomotor skills of CPR. Unfortunately most people who learn CPR by this method do not retain their skills for long. Even those who care for high-risk patients tend to forget what they have learned,[72,73] probably because they do not practice their skills. Only highly motivated family members use video self-instruction or other materials to practice, review, and maintain their knowledge and skills.[72] The less educated, males, and elderly learn CPR poorly without instructor training and support. Studies[72,73] of these groups show that instructor-led CPR training is more effective in terms of CPR knowledge and skills than video self-instruction. Participants at the international Guidelines 2000 Conference agreed that the evidence supports the following conclusions:

Validated learning systems are effective methods for conveying initial CPR skills but only for motivated families and caretakers (Class IIb).

Video self-instruction without manikins or instructor feedback fails to yield an adequate level of BLS skills after initial training (Class Indeterminate; not recommended).

Summary: Innovative Teaching Featuring Video-Based Instruction for Healthcare Professionals and the General Public

Any reference to video-based instruction and learning must be placed in context with the ways in which videotapes are used in modern CPR training.

Passive Watching

The passive watching technique conveys information only. The video gives an overview of knowledge and skills and may be motivational. We do not know how much of the information is actually learned, but students reportedly "feel more comfortable" after passively watching a video.

TABLE 5. Core Objectives of BLS Training

Immediately after a BLS course (initial skill acquisition) and any time <1 year after training (remote skill retention), the BLS provider who encounters an unresponsive person should be able to

1. Recognize unresponsiveness or other emergency situations when resuscitation is appropriate (eg, the victim does not have a "do not attempt resuscitation" order)
2. Phone the EMS number at the appropriate time within the BLS sequence
3. Provide an open airway using the head tilt–chin lift or jaw-thrust technique
4. Provide effective rescuer ventilations (breathing) that make the chest rise using the mouth-to-mouth, mouth-to-mask, or mouth-to–barrier device technique
5. Recognize and relieve FBAO in *conscious* victim as a part of the core breathing step (lay providers are not required to perform this step in unconscious victims)
6. Provide proper chest compressions sufficient to generate a palpable carotid pulse
7. Perform all skills in a manner that is safe for the rescuer, victim, and bystanders

If use of an AED is taught as part of the course, an additional core objective is to

8. Use an AED safely, correctly, and in the appropriate sequence

*Learn or Practice **While** Watching*

In this technique the student watches the instructor on a monitor and attempts to follow the actions demonstrated by the instructor. This technique was used in the pioneering studies of Brennan, Braslow, Kaye, Todd, and others. Researchers have evaluated this technique more than any other video-based technique using the highest level of methodology. This technique does not require the presence of an on-site instructor but does require personal manikins for each student.

*Learn or Practice **After** Watching*

In this technique students watch a video with an instructor demonstrating brief but critical actions (eg, head tilt–chin lift). The on-site instructor pauses the video after each action and closely observes the students as they perform the actions demonstrated by the video instructor. This sequence of "watch then practice" is repeated until all students learn the particular action. On-site instructors and manikins for each student are required. This technique can lead to standardized CPR education if the same videotape is used across the country. Such courses are so tightly scripted that instructor flexibility is markedly restricted. Nevertheless this approach is popular among instructors because their role is important and demanding.

The traditional CPR training model that allows maximum instructor flexibility has resulted in transmission of inconsistent information and insufficient practice time for students, resulting in poor outcomes at the end of training.[46–51,59] Rather than prohibit instructor flexibility, the AHA ECC Committee aims to improve the consistency of information presented and maximize skill practice time by incorporating more video-based experiences and extra time for hands-on practice.

Past attempts at video-based training without manikin practice (passive watching model) resulted in poor initial and long-term outcomes.[58] Passive watching combined with review of written materials is a somewhat successful model for renewal courses.[56] In 1 study investigators mailed videotapes to laypersons in a county-wide area to determine whether a free 10-minute lesson in CPR

would result in an increase in the percentage of arrests in which a witness or bystander started CPR. Under the actual arrest situations in this study, the investigators could detect no effect of the videotape.[57]

The same investigators attempted to provide CPR instruction through public service announcements delivered in the early morning hours. This initiative did result in a statistically significant increase in performance of bystander CPR.[74] Recently Braslow and Todd[59–61] showed that video self-instruction could teach adequate adult 1-rescuer CPR skills in 30 minutes. This contrasted with the 4 hours required in the traditional CPR course. The study noted that less hands-on practice time occurred during the traditional 4-hour course than during the 30-minute video-based course.

Video instruction was initially incorporated into AHA courses during pilot studies conducted by Edward Stapleton and Tom Aufderheide of the Heartsaver AED Course. The Heartsaver AED Course teaches 1-rescuer adult CPR, use of the pocket mask, and use of an AED.[16] All of these skills are taught and learned using the practice after watching technique.

Video-based instruction has many advantages: consistency of content, less time required for skills demonstration, more time for skill practice, and a shift from a teacher-centered to a student-centered classroom environment. Video also has the potential to motivate students by presenting real-life cases. Video is a visually stimulating educational tool. Practice after watching video-based instruction with instructor feedback is a validated primary learning strategy for training of lay rescuers (Class IIa).

Audio devices that talk the rescuer through the steps of CPR in the classroom have also been used to enhance performance during CPR instruction.[63,64] These devices can enhance learning for individuals who cannot be reached by traditional lecture methods. Audio prompting devices facilitate consistent repetitive practice, which results in improved initial acquisition and retention of skills. Use of audio prompting devices is recommended (Class IIb).

CPR in the Schools

Several studies in the 1990s led to rediscovery of the value of teaching CPR in schools. In 1998 the AHA began a large-scale evaluation of CPR in schools in the United States. Experts at the international Guidelines 2000 Conference strongly recommended development of in-school CPR programs as a *primary educational strategy* to ensure widespread learning of CPR and other BLS skills. Because 70% to 80% of cardiac arrests occur at home,[3] widespread training of a national population is needed to increase the likelihood of CPR being performed before the arrival of EMS personnel.

PAD programs that provide AEDs for individual homes are not expected to provide much benefit because of the small population that would be served and the cost of AEDs.[15] CPR is a critical action that can be performed in the home, where adolescents are often present. In addition, the major causes of death in school-aged children are unintentional injury, drowning, suffocation, and other conditions treatable with BLS. In 1998 the AHA trained 2.4 million lay rescuers in adult and pediatric CPR,[75] approximately 0.9% of the US population. Evidence gathered about CPR in schools included findings of 7 studies (level of evidence 3). All 7 studies support this guideline and present no opposing evidence. These studies have consistently demonstrated the effectiveness of school-based curriculums in ensuring both knowledge and skills retention consistent with outcomes among adult populations.[76–81]

Teaching CPR in schools is a powerful educational strategy. Research is needed to identify the best content, process, and structure of the curricula. Such a program will ensure widespread dissemination of CPR and other BLS skills to citizens around the world. The evidence for these recommendations does not include evidence from prospective, randomized clinical trials. Therefore, the concept of CPR in midlevel schools does not yet merit a Class I recommendation.

TABLE 6. Course Elements Versus Allowed Variability

Element of Course	Variability
Course format and style	High, based on participants' needs
Course objectives (knowledge and skills to learn)	Constant
Evaluation methods and tools (checklists, written evaluations)	Constant

For maximum benefit to the participants, all evaluation instruments (eg, checklists of actions) should be shared with participants throughout the learning process, including *before the course* (to facilitate preparation), *during the course* (to provide real-time feedback and direct efforts for improvement), and *after the course* (to refresh memory and to stimulate practice).

Evaluation: A Process to Improve Learning

Evaluation in ECC courses is critical for both instructors and students. Evaluation helps achieve the overall course goal of having each participant acquire the skills and knowledge needed for his or her role in a potentially life-threatening situation. Teachers must teach effectively and students must learn effectively. Evaluation provides the tools by which instructors and students measure their success and plan for improvement. Evaluation of ECC courses has multiple overlapping purposes:

1. To help students identify areas in which they require more learning and review
2. To help instructors identify students who need additional help and the areas in which they need help
3. To help instructors identify topics or skills in which they can improve their organization, use of time, teaching techniques, or understanding
4. To help the course director identify areas of the course that require revision and assess the overall success of the course
5. To support efforts to improve the quality of the course within and across community training programs and larger training networks
6. To support consistency in course objectives and outcomes across community training programs and larger training networks
7. To provide participants with additional motivation to study and review

Variability in Students Versus Variability in Courses

Persons who participate in ECC courses have different needs, skills, experiences, motivation, and learning styles. This diversity requires flexibility in presentation and format that must be balanced against the need for predictable educational outcomes. Course objectives, however, must remain consistent across the training network. Uniform course objectives can be maintained by use of standardized evaluation instruments. Table 6 lists the elements of ECC courses, areas in which variability is allowable, and the level of variability that is allowable.

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Part 2: Ethical Aspects of CPR and ECC

Introduction

CPR and ECC have the same goals as other medical interventions: to preserve life, restore health, relieve suffering, and limit disability. One goal unique to CPR is the reversal of clinical death, an outcome achieved in only a minority of patients. The performance of CPR, however, may conflict with the patient's own desires and requests or may not be in his or her best interest.[1,2] Decisions concerning CPR are complicated and often must be made within seconds by rescuers who may not know the patient or know of the existence of an advance directive. Resuscitative efforts may be inappropriate if goals of patient care cannot be achieved. In some instances resuscitation may not be the best use of limited medical resources. Concern about costs associated with prolonged intensive care, however, should not preclude emergency resuscitative attempts in individual patients.

The purpose of this section is to guide ECC healthcare professionals in making difficult decisions to start or stop CPR and ECC. These are general guidelines. Each decision must be made for the individual, with compassion, based on ethical principles and available scientific information.

Ethical Principles

When beginning and ending resuscitation attempts, differences in ethical and cultural norms must be considered. Although the broad principles of *beneficence, nonmaleficence, autonomy,* and *justice* appear to be accepted across cultures, the priority of these principles may vary among different cultures. In the United States the greatest emphasis is placed on individual patient autonomy. In Europe a greater emphasis on the autonomy of healthcare providers and their duty to make informed decisions about their patients is emerging. In some societies the benefits to society at large outweigh the autonomy of the individual. Physicians must play a role in decision making regarding resuscitation. Scientifically proven data and societal values should guide resuscitative efforts, while at the same time we strive to maintain cultural autonomy.

The Principle of Patient Autonomy

Patient autonomy is generally respected ethically and in most countries legally. This, however, requires a patient who can communicate and can consent to or refuse an intervention, including CPR. In many countries, including the United States, adult patients are presumed to have decision-making capacity unless a court of law has declared them incompetent to make such decisions. In other countries court decisions are not necessary to establish incompetence based on psychiatric illness.

Truly informed decisions require that patients receive and understand accurate information about their condition and prognosis, the nature of the proposed intervention, the alternatives, and the risks and benefits. The patient must be able to deliberate and choose among alternatives and be able to relate the decision to a stable framework of values. When in doubt, the patient should be regarded as competent. When decision-making capacity is temporarily impaired by such factors as concurrent illness, medications, or depression, treatment of these conditions may restore that capacity. In an emergency, patient preferences may be uncertain, with little time to determine them. In this instance it is prudent to give standard medical care.

People rarely plan for future illness. Many do not wish to prepare advance directives or to discuss CPR. Physicians seldom discuss advance directives, even with their seriously ill patients. Many patients have only a vague understanding of CPR and its consequences. The public generally overestimates the probability of survival from cardiac arrest. Some patients will decline CPR because of the possibility of severe residual neurological deficit with survival. In fact, in many studies the quality of life for survivors of cardiac arrest has been described as acceptable.[3]

The physician and patient, however, may differ in their perceptions of quality of life. Physicians have an obligation to determine a patient's understanding of CPR and resuscitation outcomes. Appropriate decision making rests on a good understanding and, if necessary, a discussion of perceptions and outcomes. This goal also can be complicated by physicians' misconceptions. Many physicians, for example, cannot accurately predict chance of survival from cardiac arrest. Enabling patients to give truly informed consent for resuscitation continues to be a challenge for healthcare providers.

There is some evidence that surrogates, acting on behalf of patients who have lost their decision-making capacity, do not always accurately reflect the patients' preferences. Approximately one third of patients with chronic renal disease would accept the decisions of a surrogate, even if those decisions conflicted with their own expressed wishes.[4] It is most helpful to establish patient preferences in advance by discussing the subject with the patient at admission to the hospital, but patients must not be coerced into providing advance directives.

Advance Directives and Living Wills

Advance directive is the term applied to any expression of a person's thoughts, wishes, or preferences for his or her

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