Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care

Recommendations of the 1992 National Conference

American Heart Association

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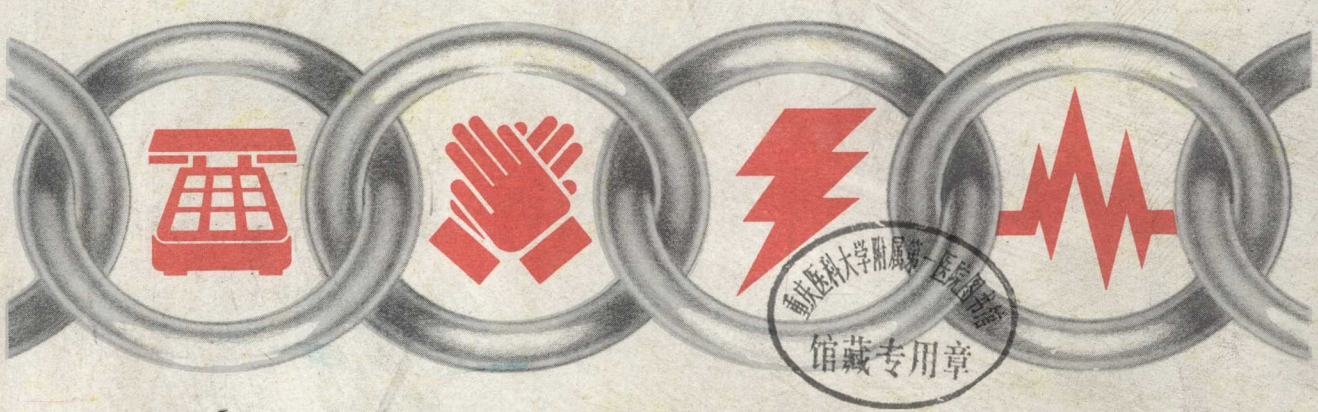
Chain of Survival



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Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care

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American Red Cross
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Heart and Stroke Foundation of Canada
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Part I

Introduction

THIS publication is the product of the 1992 National Conference on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC) and represents an update of the recommendations published in 1974[1] and updated in 1980[2] and 1986.[3] The proceedings of the conference, planned for publication in the *Annals of Emergency Medicine* in early 1993, review the science that led to the formulation of these guidelines for CPR and ECC. The recommendations given here are intended as guides for the proper training in and performance of CPR and ECC. Like the previous recommendations, these represent a consensus of experts from a variety of disciplines. But since CPR and ECC are dynamic disciplines that continue to develop through ongoing experience and research, there is no intent to limit the adoption of new advances as they emerge. Deviations from these recommendations and guidelines may be warranted when a trained physician proficient in CPR and ECC recognizes that such is in the best interest of the patient.

The recommendations of the 1992 Conference on Cardiopulmonary Resuscitation and Emergency Cardiac Care do not represent broad changes, nor do they suggest that care provided under past guidelines is either unsafe or ineffective. These guidelines are considered the most effective and the most easily teachable that current knowledge and experience can provide.

A HISTORICAL PERSPECTIVE

In the past 30 years, since the introduction of modern techniques of CPR, there have been dramatic advances in ECC of victims of profound circulatory collapse and cardiac arrest. These techniques have restored the lives of many people when breathing has ceased and the heart has stopped beating. For those with spared neurological function and treatable cardiopulmonary disease, prolonged and vigorous life may ensue.

Sporadic accounts of attempted resuscitation are recorded since antiquity,[1,4,5] but until 1960 successful resuscitation was largely limited to occasional victims of respiratory arrest. Emergency thoracotomy with "open chest massage" was described in the 1950s and was often successful if definitive therapy was readily available.[6] Electric reversal of ventricular fibrillation by externally applied electrodes was described in 1956.[7] The ability to reverse a fatal arrhythmia without opening the chest challenged the medical community to develop a method of sustaining ventilation and circulation long enough to bring the defibrillator to the patient's aid. In 1958 adequate rescue ventilation with mouth-to-mouth technique was described.[8,9] In 1960 "closed-chest" compression was described, ushering in the modern era of CPR.[10] The simplicity of this technique has led to its widespread dissemination: "All that is needed are two hands."[10] The interaction of closed-chest compression with mouth-to-mouth ventilation was developed as basic CPR, which offered the hope for substantially reducing the nearly 1000 sudden deaths that occurred each day in the United States before the patients reached the hospital.

PREVIOUS NATIONAL CONFERENCE RECOMMENDATIONS

In 1966 a National Academy of Sciences–National Research Council (NAS-NRC) conference on CPR recommended the training of medical, allied health, and other professional personnel in the external chest compression technique according to the standards of the American Heart Association (AHA).[11,12] Widespread acceptance of the theory of CPR among health care professionals ensued. Nevertheless, training, particularly of physicians, was not prevalent in most parts of the country. From 1965 to 1973 large strides toward implementation were made by the AHA through its training materials and programs, by the NAS-NRC through its publications, by the reports of the Inter-Society Commission for Heart Disease Resources, and by the recommendations and evaluations of government agencies, professional medical societies, and private groups.

In 1973 a second national conference on CPR and ECC, cosponsored by the AHA and the NAS-NRC, recommended that (1) CPR training programs be extended to the general public; (2) training in CPR and ECC be in accordance with AHA standards and that the AHA continue to review scientific data and clinical experience and revise and update these standards accordingly; (3) certification of competence at various levels of life support be based on nationally standardized curricula that include written and performance tests; (4) provision of basic and advanced life support (BLS and ALS) by highly trained personnel be required for all life support units and hospitals on an integrated, stratified, communitywide basis; (5) these goals be implemented by legislation and medicolegal action, where needed, to ensure access to effective CPR and ECC for the entire population; and (6) recognition of early warning signs of a heart attack and emphasis on access to the emergency medical services (EMS) system be included in the definition of ECC. In addition, the 1973 national conference defined the role of the American Red Cross and other agencies in training the lay public, the

role of emergency care units in stratified systems providing ECC, and problem areas and possible approaches to medicolegal aspects of CPR and ECC. The recommendations and specific standards were published as a supplement to the *Journal of the American Medical Association* (*JAMA*).[1]

The third national conference was held in 1979 amid growing worldwide enthusiasm for CPR and ECC. The conference recognized a responsibility to recommend new techniques if they promised advances in lifesaving potential. The major thrust of the 1979 conference was to develop standards and guidelines in CPR and ECC. They were described as encompassing (1) principles, techniques, and standards for the performance of BLS; (2) principles, techniques, and guidelines for the performance of advanced cardiac life support (ACLS); (3) recommendations for training, testing, and supervising medical and allied health personnel; (4) policies for the role of the American Red Cross and other agencies in training the lay public; (5) renewed strong emphasis on community responsibility for the morbidity and mortality of coronary heart disease and for organized implementation of primary and secondary prevention programs in parallel with ECC efforts; (6) definition of the role of ECC units in stratified systems of emergency care; (7) clearer understanding of the medicolegal aspects of CPR and ECC; (8) clearer definition of responsibility in life support for infants and children; (9) principles, techniques, and standards for the performance of BLS in infants and children; and (10) principles, techniques, and guidelines for the performance of ALS in neonates. The 1979 conference underscored the importance of risk factor modification and preventive measures, as well as early response and bystander CPR, by emphasizing that the community "deserves to be recognized as the ultimate coronary care unit."[13]

In 1983 the AHA convened a national conference on pediatric resuscitation with representatives of many organizations responsible for the health care of infants and children. The conclusions of this conference were that (1) guidelines were needed for pediatric BLS and ALS, with separate guidelines for neonatal ALS; (2) the AHA should set these guidelines; and (3) courses should be developed for pediatric BLS, pediatric ALS, and neonatal resuscitation. These three courses, under the cosponsorship of the AHA and the American Academy of Pediatrics, were introduced in 1988.

The fourth national conference on CPR and ECC, convened in July 1985, made changes to the existing guidelines and recommendations based on research and clinical data since 1979. The American Academy of Pediatrics reviewed and endorsed the recommendations on pediatric BLS and ALS, beginning an ongoing relationship with the AHA. The conference scrutinized proposed changes for the soundness of experimental and clinical evidence. In addition, the best interests of the public were considered regarding safety, effectiveness, teachability, and ease of sequencing changes into related maneuvers. The conference recognized that there was a paucity of sound data in many areas of BLS and ALS. To optimize the lifesaving efficacy of the CPR-ECC program, the conference encouraged funding agencies to scrutinize CPR-ECC research requests and to fund those that were deserving.

The conference (1) encouraged targeting CPR training efforts to the appropriate recipients; (2) endorsed the early use of thrombolytic therapy in acute myocardial infarction (MI); and (3) emphasized the importance of early defibrillation.[3]

STANDARDS AND GUIDELINES

The term *standards* was used in the 1974 *JAMA* supplement,[1] "Standards for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC)," in recognition of the consensus achieved in the recommendations and basic concepts in BLS and ACLS. This consensus resulted in the development of consistent BLS teaching materials by different agencies, particularly the AHA and the American Red Cross. Implementation of ACLS recommendations resulted in the development of an ACLS teaching-testing package by the AHA in 1975. The term *standards* suggested a need for uniformity and consistency to maintain quality control. However, it was also clear that a degree of flexibility was necessary to facilitate the introduction of innovations based on new data and to protect the physician's prerogative for discretionary action, particularly because the term *standards* has important legal as well as medical connotations. As a result, the title of the *JAMA* supplement was changed for the 1980 publication to "Standards and Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC),"[2] with the term *standards* meant to apply to BLS teaching, especially as it referred to laypersons, whereas *guidelines* applied largely to ACLS teaching.

The terms *standards* and *guidelines* were not intended to imply that physicians qualified and experienced in CPR and ECC may not be justified in deviating from recommendations under appropriate circumstances or that new knowledge, new techniques, clinical or basic research data, clinical experience, or circumstances may not provide sound reasons for an alternative approach to CPR and ECC before the next definition of standards and guidelines.

The term *standards* has been misunderstood and has often been given legal implications it was never intended to convey. For this reason the term has been avoided in this publication. The term *standards* has been replaced with *guidelines* and *recommendations* without thereby suggesting that strongly recommended techniques or performance guidelines are to be de-emphasized or that uniformity and consistency are unimportant. The strength of a recommendation is determined by the scientific evidence on which it is based.

THE 1992 NATIONAL CONFERENCE RECOMMENDATIONS

The fifth national conference on CPR and ECC was convened in February 1992. Considerable experimental and clinical research data had been published since the 1985 conference. Indeed, developments since the last conference necessitated that the AHA's ECC Committee address events before the 1992 national conference. Accordingly, supplemental guidelines about transmission of infectious disease[14] and early defibrillation[15,16] and a teaching module on automated external defibrillators[17] were published and disseminated during the years leading to the conference, with the understanding that these interim recommendations would be further discussed at the conference.

Conference Objectives

The objectives of the 1992 national conference were to (1) review and revise past conference recommendations in light of recent scientific and clinical data; (2) provide recom-

mendations for prevention for all CPR-ECC programs; (3) review and recommend changes in methods of education and evaluation; (4) provide guidelines for evaluating the efficacy of CPR-ECC programs, including their effectiveness in reaching and teaching the target populations; and (5) provide ethical guidelines for withholding or withdrawing CPR or ACLS in appropriate circumstances.

Criteria for Evaluating Scientific Data

Criteria to be followed by the conference participants in evaluating the scientific literature and for changing existing guidelines and recommendations were developed by the AHA's ECC Committee. Studies meeting these criteria were considered for review and served as the basis for making recommendations. Basic and clinical scientists, educators, and program implementors subjected each proposed recommendation to these criteria before reaching a consensus. Representatives from many major clinical and scientific organizations participated in the process, and there was an unprecedented international presence. Recommendations, whether new or unchanged, were graded by the weight of the supporting scientific evidence. As at past conferences, recommendations for new treatment options were also reviewed for their safety, effectiveness, teachability, and ease of sequencing into related maneuvers.

Study Design and Method.—The first criterion used in evaluating the scientific literature concerned the design and methods of a study. Randomized, placebo-controlled studies were preferred. If a placebo group was not used, then a control group that was clinically and historically appropriate was considered acceptable. Studies blinded to intervention were preferred; if this was impossible, randomization in the study design had to be timed so as to minimize investigator-operator bias. Particularly if neurological outcome was an end point, the evaluator should have been blinded to the study randomization. Clinically relevant methods should have been used, and the sample size should have been large enough to minimize error. The data analysis used and the end points examined should have been appropriate for the study design.

Source of the Study.—The second criterion concerned the source of the study. It was considered desirable that more than one study yielding similar results be available and that studies come from at least two separate groups of investigators. The studies should have been published in peer-reviewed journals. The conference also considered studies that were still in review if the consensus was that they were meritorious and important. The studies were not restricted to US literature.

Ethics of the Study.—The third criterion concerned the ethical conduct of the study. All animal and human studies reviewed had to have been approved by appropriate institutional review boards if they existed, and the ethical conduct of the study had to have been considered commensurate with acceptable clinical practice, especially in terms of obtaining informed consent.

Feasibility of the Proposed Recommendation.—A fourth criterion had to be met before a recommendation for change was made. The recommendation had to be feasible; ie, the treatment option or intervention had to be teachable to those who were to carry it out, and necessary equipment had to be available or easy to obtain.

Classification of Therapeutic Interventions in CPR and ECC

A system of classifying recommendations based on the strength of the supporting scientific evidence was used.

Class I.—A therapeutic option that is usually indicated, always acceptable, and considered useful and effective.

Class II.—A therapeutic option that is acceptable, is of uncertain efficacy, and may be controversial.

Class IIa.—A therapeutic option for which the weight of evidence is in favor of its usefulness and efficacy.

Class IIb.—A therapeutic option that is not well established by evidence but may be helpful and probably is not harmful.

Class III.—A therapeutic option that is inappropriate, is without scientific supporting data, and may be harmful.

Magnitude of the Problem

Cardiovascular disease accounts for nearly 1 million deaths in the United States annually (nearly 50% of deaths from all causes), including approximately 500 000 deaths due to coronary disease, a majority of which are sudden deaths.[18] More than 160 000 of these deaths occur before the age of 65 years, and more than half of all deaths from cardiovascular disease occur in women.[19] Coronary heart disease is a major cause of morbidity and mortality in women beyond their middle to late 50s.[20] It has been estimated that more than 5 million years of potential life are lost owing to cardiovascular disease in the United States annually.[19]

Death rates from cardiovascular diseases have been declining over the past several decades.[19,21] From 1979 to 1989, the death rate from coronary heart disease fell 30%, and the death rate from stroke fell 31.5%. Advances in medical treatment and healthier life-styles have undoubtedly played a role, but there is still much room for progress.[21] In 1990, 3.6 million persons were hospitalized with a first-listed discharge diagnosis of heart disease and approximately 675 000 with a diagnosis of acute MI.[18] Forty-five percent of all heart attacks occur in people under age 65.[19] Based on 1989 statistics, an estimated 6.2 million Americans have significant coronary heart disease. Many of these people are at increased risk for sudden death or MI. Approximately two thirds of sudden deaths due to coronary disease take place outside the hospital and usually occur within 2 hours after onset of symptoms.[19,22-27]

Thus, sudden death related to coronary artery disease (CAD) is the most prominent medical emergency in the United States today. It is possible that a large number of these deaths can be prevented by prompt action to provide rapid entry into the EMS system, prompt provision of CPR, and early defibrillation.[28-33] In addition, many victims of drowning, electrocution, suffocation, and drug intoxication most likely could have been saved by the prompt initiation of CPR and early use of ALS. The prompt application of ALS techniques in the neonatal period promises not only to save lives but, by avoiding brain damage, also to prevent lifetimes of suffering and economic drain.

Trauma is the major cause of death and debility in the pediatric and young adult population (ages 1 to 44 years).[34-36] The emphasis on trauma prevention in the pediatric programs promises to educate a large segment of the lay public in injury prevention.

Prospects for the Future

Since the majority of sudden deaths caused by cardiac arrest occur before hospitalization, it is clear that the community must be recognized as "the ultimate coronary care unit."[13] The CPR-ECC programs have been and will continue to be valuable formats with which to educate the community about its responsibility and to control the morbidity and mortality from coronary heart disease and from preventable accidents. These programs should incorporate education in primary prevention, including risk factor detection and modification and signals of impending cardiovascular events, and secondary prevention, aimed at preventing sudden cardiac death and MI in patients known to have coronary heart disease. It is clear that CAD and other forms of atherosclerotic vascular disease are supported by community nutritional patterns, prosmoking messages delivered to children, and cultural and social pressures that mold unhealthy behaviors and life-styles. Persuasive data argue in favor of aggressive community action, and optimal resources necessary for the primary prevention of atherosclerotic disease have been defined.[37]

Risk Factor Modification.—Mortality from coronary heart disease, stroke, and other cardiovascular diseases has declined dramatically from the mid-1960s to 1989. The decline has averaged approximately 2% to 3% annually.[21,38-42] Among these declines, that of coronary heart disease mortality has had the greatest impact on life expectancy.

A number of factors have undoubtedly contributed to the decline in cardiovascular disease mortality: improved approaches to cardiovascular disease diagnosis and therapy, use of drugs that have a cardioprotective effect on persons at high risk, improved revascularization techniques, improved ECC, and modification of cardiovascular risk factors in the population.

Reduction of risk factors at a young age can be expected to have the greatest impact. Nevertheless, intervention later in life must not be ignored, since preventive measures have been shown to slow the progression of and even reverse arterial disease and can be expected to reduce morbidity and mortality as well. Clearly some risk factors cannot be changed. These include heredity, gender, race, and age. Major risk factors that can be changed or modified include cigarette smoking, hypertension, elevated cholesterol levels, elevated triglyceride levels, lack of exercise, obesity, stress, and diabetes.

Cigarette Smoking.—Cigarette smoking can initiate and contribute to the atherosclerotic process and to its complications—MI, stroke, and sudden death.[43,44] Cigarette smoking is the most important single cause of preventable death in the United States.[45] It has been estimated that one of 10 Americans living today will die prematurely, most of them suddenly, as a result of cigarette smoking.[46]

An important positive note is that people who stop smoking return very rapidly to the risk level of nonsmokers, especially for the risk of sudden death.[47-52] There is evidence that hemodynamic and metabolic events associated with cigarette smoking may be mediated by catecholamine release[53] and that catecholamine release lowers the threshold for ventricular fibrillation,[54,55] as does cigarette smoking.[56] These observations have further strengthened the argument that a cause-and-effect relationship exists between cigarette smoking and coronary heart disease mortality. A recent study has shown a markedly increased occurrence of silent ischemia among smokers.[57] Filter-cigarette smoking has not been shown to decrease mortality rates. On the contrary, there is some evidence that filter-cigarette smokers have a higher risk for MI than all other smokers.[50,58] Inhalation of environmental tobacco smoke, ie, "passive smoking," has also been associated with an increased risk of smoking-related disease, with the majority of deaths attributed to heart disease.[59,60]

Hypertension.—A large number of studies have documented the important role of high blood pressure in the development of CAD, stroke, renal failure, and heart failure. Evidence suggests that a systolic blood pressure of 160 mm Hg or more or a diastolic blood pressure of 95 mm Hg or more is associated with a twofold to threefold increase in the risk of CAD.[50] Hypertension is a major risk factor for coronary heart disease and is the major risk factor for left ventricular hypertrophy, which is thought to be an independent cause of arrhythmia and sudden death. It is estimated that more than 62 million Americans have hypertension, 41.5 million of these being younger than 65 years.[61,62] Control of hypertension has been shown to decrease the incidence of stroke dramatically.[63] Thus, effective control of hypertension can be expected to have an important impact on cardiovascular disease mortality. In recent decades there has been marked improvement in the treatment and control of hypertension.[64]

Cholesterol.—There is clear evidence that the risk of CAD increases in populations as the level of total cholesterol increases.[65] This association may be diminished in the elderly[66,67] but still exists as an independent risk factor for coronary events and mortality from CAD.[68,69] Low-density lipoprotein cholesterol is positively associated with the risk of CAD,[67,70] and high-density lipoprotein cholesterol is negatively associated.[71] The Framingham Study has shown that the ratio of total cholesterol to high-density lipoprotein is as good as any test to predict the risk for CAD in asymptomatic persons. Definitive evidence that reduction in serum levels of cholesterol will reduce the incidence of cardiovascular events was provided by the Lipid Research Clinics Coronary Primary Prevention Trial.[72,73] Thus, aggressive efforts in the form of dietary changes and, if necessary, pharmacologic interventions to reduce elevated blood cholesterol levels should be encouraged and can be expected to have a proportionate impact on reduction of CAD mortality.[74,75]

Triglycerides.—Recent evidence suggests that serum triglycerides are positively associated with the risk of CAD, especially in women.[76] Strategies to lower serum cholesterol are often effective in lowering serum triglycerides as well.

Lack of Exercise.—There is considerable evidence that persons who engage in regular physical activity have a reduced risk for CAD when compared with those who lead a sedentary life-style.[77-81] A review of the findings of 27 studies has concluded that a beneficial effect of physical activity is reduction of the risk of CAD.[82]

Obesity.—Obesity is associated with several risk factors for CAD, including hypertension, hypercholesterolemia, and diabetes.[83-86] Obesity is also likely to be an independent risk factor; ie, it may directly influence the risk of CAD.[87-89] It is clear that among obese persons reduction of weight, through decreased caloric intake or increased physical activity or both, is highly desirable.

Stress.—Chronic psychological stresses have long been suspected of being associated with CAD.[90,91] An overactive

"fight-or-flight" response may have an adverse effect on catecholamines as well as on blood clotting. Type A, or "coronary-prone," personality is characterized by competitiveness, impatience, intense drive and desire to achieve, and a sense of urgency.[92] Early investigations suggested a positive association of the type A personality and CAD.[93,94] However, recent large studies have failed to demonstrate an association.[95-98] More recent studies have focused on suppressed anger and aggressiveness.[99-101] A number of studies have failed to document a relationship between hostility and CAD.[102-104] However, stress reduction techniques have been shown to lower blood pressure and facilitate control of hypertension and may be useful in improving a person's life-style.[105-107]

Patients at High Risk.—Persons at high risk for cardiovascular disease because of factors such as diabetes mellitus, family history of premature cardiovascular disease, and prior MI should be made aware that their risk may be significantly increased if they have other risk factors, such as hypertension, hyperlipidemia, or cigarette smoking. Reduction of risk can be expected with regular exercise and weight control. Control or elimination of those factors amenable to change may be expected to contribute substantially to risk reduction in this group. Thus, it is important to teach the families of patients at high risk both CPR and the importance of improving risk factor status.

Conclusions and Goals.—The following statements should be given the broadest possible publication and promotion.

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 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.

Millions of persons, both lay and professional, have been trained in CPR-ECC. Strong prevention messages delivered during CPR training may have as great an impact on cardiovascular mortality and morbidity as the teaching of emergency measures themselves. Through community education and involvement, CPR may serve as a means of controlling CAD through prevention. This aspect of CPR training requires more attention.

The goals of teaching the community to function as the ultimate coronary care unit include (1) 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; (2) a lay public able to support the life of the cardiac arrest victim until ACLS becomes available; (3) a lay public educated in the importance of early ACLS and eager to support an effective EMS system in the community; (4) recognition and reduction of reversible risk factors among the population with known CAD (secondary prevention); and (5) recognition and reduction of reversible risk factors among the population free of clinical manifestations of CAD, especially the young (primary prevention).

Efforts to accomplish these goals are already under way in many areas. Scientific knowledge of the pathogenesis of CAD and mechanisms of sudden cardiac death has greatly increased in recent years. Knowledge of the methods and importance of primary and secondary prevention of CAD is becoming more widespread. The layperson should consider learning CPR a responsibility to family, loved ones, and self.

The Responsibility to the Future

The value and cost-effectiveness of the CPR-ECC effort must continue to be monitored to justify the substantial effort and resources that volunteers and sponsoring agencies invest in it. Studies relating dollars spent to lives saved have been reported.[108-110] Such analyses are encouraged to improve CPR-ECC programs and help them reach their goal. The goal of CPR-ECC programs is to increase the number of persons reached and adequately trained, thereby increasing the number of lives saved by prevention, risk factor modification, and emergency intervention, and to do so at the most efficient cost.[111] Improving the efficacy of emergency cardiac intervention and the outcome for victims of cardiopulmonary arrest requires aggressive strategies of implementation and research. The concepts of the "chain of survival" and "cardiopulmonary-cerebral resuscitation" (CPCR) represent two such important strategies.

The Chain of Survival.—It is clear that CPR alone is of limited usefulness in improving outcome in most cardiac arrests. The outcome can be improved 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) intubation, and (6) intravenous administration of medications.[15] The interconnectedness of these events and their indispensability to the overall success of the ECC endeavor 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 chain of survival are described specifically as (1) early access, (2) early CPR, (3) early defibrillation, and (4) early ACLS.

CPCR.—Although the importance of CPR and BLS is clear and undisputed, the efficacy of basic techniques of CPR in prolonged arrest is modest at best. The initial hope for closed-chest CPR was that circulation and oxygenation could maintain viability long enough to bring the newly developed external defibrillator to the victim's aid.[10] Up to a point, this modest hope has been realized; BLS is often successful if defibrillation (or other modes of definitive care) can be carried out within 8 to 10 minutes.[112-114] Unfortunately all too often this time limit cannot be met. When CPR is delayed or definitive care is not soon forthcoming, the chain of survival is broken, and the cerebral cortex, the tissue most susceptible to hypoxia, is irreversibly damaged, resulting in death or severe neurological deficit. The need to preserve cerebral viability of the arrest victim must be stressed both in research endeavors and in practical interventions. The term *cardiopulmonary-cerebral resuscitation* has been used to further emphasize this need.[115] Studies on the use of pharmacologic intervention during advanced resuscitative efforts have been under way for some years. These studies need to be continued and expanded. Practical ways to assist cerebral viability in the early stages of BLS are needed. Their development will require considerable support by funding agencies.

EMERGENCY CARDIAC CARE

ECC includes all responses necessary to deal with sudden and often life-threatening events affecting the cardiovascular and pulmonary systems as well as the ultimate viability of the fully functioning human being. Cardiac disease is by far the most frequent cause of these potentially catastrophic events. In relation to cardiac disease, ECC specifically includes (1) recognizing early warning signs of heart attack, efforts to prevent complications, reassurance of the victim, and prompt availability of monitoring equipment; (2) providing immediate BLS at the scene, when needed; (3) providing ACLS at the scene as quickly as possible to defibrillate, if necessary, and stabilize the victim before transportation; and (4) transferring the stabilized victim to an appropriate hospital where definitive cardiac care can be provided.

The term *emergency cardiac care* in this context extends to other life-threatening catastrophic events that may not initially involve the heart. These include such syndromes as the obstructed airway, stroke, near-drowning, electrocution, trauma, and hypothermia. Pediatric and neonatal resuscitation are also included, even though in most instances in this age group the primary event does not occur in the heart.

Emergency transportation alone, without life support, does not constitute ECC. Although transportation is an important aspect of ECC, the major emphasis is early provision of definitive care when needed (eg, defibrillation), use of CPR when needed, and stabilization of the victim of the life-threatening emergency (eg, control of hemorrhage). Inordinate delays at the scene must be avoided, but defibrillation when necessary and stabilization to the extent possible should be achieved before and during transport of the victim to the site of continuing tertiary care.

The two phases of ECC are BLS and ACLS. BLS is that phase of ECC that either (1) attempts to prevent arrested or inadequate circulation or respiration through prompt recognition and intervention, early entry into the EMS system, or both, or (2) attempts to support the circulation and respiration of a victim of cardiac or respiratory arrest through CPR. BLS can and should be initiated by any person present when cardiac or respiratory arrest occurs. The most important link in the CPR-ECC system in the community is the layperson. ECC is dependent for its success on laypersons' understanding the importance of early activation of the EMS system and on their willingness and ability to initiate effective CPR promptly. Accordingly, providing lifesaving BLS at this level can be considered to be primarily a public, community responsibility. The medical community, however, has the responsibility to provide leadership in educating the public and to support community education and training.

ACLS includes BLS plus 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. It also includes the establishment of communication necessary to ensure continued care. A physician must supervise and direct ACLS efforts (1) in person at the scene, (2) by direct communication, or (3) by a previously defined alternative mechanism such as standing orders.

ECC should be an integral part of a total communitywide emergency medical care system. Each system should be based on local community needs for patient care and available resources and be consistent with regional, state, and national guidelines. The success of such a system requires multijurisdictional participation and planning to ensure operational and equipment compatibility within the system and between adjacent systems. The community must be willing both to fund the program it develops and to review its efficacy. The initial planning of a system should be through a local advisory council on emergency services charged with assessing community needs, defining priorities, and arranging to meet those needs with available resources. Critical evaluation of operating policies, procedures, statistics, and case reports must be the continuing responsibility of the medical director. Operational activities must be evaluated against adopted protocols. Evaluation of skills of trained personnel, whether based in or out of the hospital, must be conducted on a regular schedule. Continuing education programs must be developed that prevent deterioration of necessary skills.

The ECC segment of a communitywide emergency system is best provided through a stratified system of coronary care having three levels: level 1, ECC units, including basic and advanced *fixed* ECC units and basic and advanced *mobile* ECC units capable of defibrillation[15,16]; level 2, emergency care units, coronary care units, and intermediate care units capable of thrombolytic therapy[116,117] and intensive care; level 3, tertiary care centers capable of coronary revascularization and other necessary interventions.

Public education, professional education, and emergency medical communications are essential components of the total emergency system and are discussed below and in Part IX, "Ensuring Effectiveness of Communitywide Emergency Cardiac Care."

EDUCATION

Public Education

The greatest risk of death from heart attack occurs within the first 2 hours after the onset of symptoms.[31,33] The success of thrombolytic agents in decreasing the mortality and morbidity of acute MI has increased the urgency for early care in this disease.[116,117] The efficacy of thrombolytic therapy in altering the course of an acute MI decreases rapidly with time. Beyond 6 hours after the MI the value of thrombolytic therapy is limited.[118-125] The public, especially those at high risk and their families and friends, must be educated to recognize the usual signs of a heart attack and the need for prompt attention.[126] They must be taught how to gain rapid access to the EMS system.[127,128] The optimal way to facilitate EMS response is through the use of a universal emergency telephone number, such as 911.[129,130] The community must take responsibility to ensure that calling this number initiates a rapid response. Once this number has been established, it must be promoted through an educational program so that it will be identified in the minds of as many as possible within the community as the means for immediate access to emergency care.

Each person should have a well-formulated plan of action for use in an emergency, based on local community resources and the EMS system. When symptoms occur that suggest an MI, a mobile life support unit should be summoned to reduce elapsed time from onset of symptoms to entry into an EMS system. In the absence of such a system, the victim should proceed without delay to an emergency department or other facility with 24-hour life support capability. The victim should

be accompanied by someone else, whenever possible, to drive and to assist if necessary.

General Concepts and Purpose of Resuscitation Education

Programs in CPR-ECC should incorporate the best scientific data available into the teaching and practice of resuscitation. The development of these programs involves the efforts of national and international organizations to review the data and develop guidelines for resuscitation,[3] which are translated into programs for the lay public and health care professionals. The purpose of these programs is strictly educational.

It should not be the role of the AHA to certify the competency of the health care provider in BLS or ALS. Other groups, such as licensing agencies, medical specialty boards, hospitals, health departments, and EMS authorities, are responsible for certifying clinical competency. Those responsible may adopt criteria for evaluation or they may develop their own methods. Retraining is also an important issue: resuscitation skills deteriorate at a variable rate, so credentialing groups should determine how often knowledge and skills should be assessed. To emphasize that ECC courses are strictly educational, the AHA, for example, has removed the word *certification* from provider cards, substituting the term *course completion* for all ECC courses. The document of course completion may be given to a participant who has (1) attended the required course, (2) achieved a successful evaluation on the core content, and (3) remedied any deficiencies when the course was given. Courses using some of the AHA materials but not covering the core content may be valid educational experiences and of high quality but do not qualify for documentation of AHA course completion.

Education in BLS

Adult programs in BLS must be designed to motivate persons to be trained in CPR and to use the acquired skills. Targeting courses to relatives and close friends of persons at high risk must be continued. Students bring a number of concerns to these courses, and these must be addressed. These concerns include fear of imperfect performance, fear of responsibility, anxiety, guilt, and fear of infection. In addition, students are frequently reluctant to perform CPR even after they are trained.[131] Programs must therefore incorporate information about willingness to perform CPR, and students must be encouraged to develop an individualized action plan in the event of an emergency.

Retention is another key issue in BLS education.[132-136] To improve retention, the multiple performance steps should be simplified and key factors that determine successful performance and outcome highlighted. Flexible approaches to education, such as public service announcements and use of videotapes, should be encouraged.

Since laypersons attend BLS programs to learn skills and to acquire knowledge, the barriers and anxiety resulting from formal testing must be removed. Formal testing (pass/fail) is not recommended for BLS training of the layperson. Instead of testing, timely feedback on knowledge and skills acquisition will allow the learner to evaluate his or her performance and correct deficiencies by practice or review of the student manual.

The evolution of varying levels of expertise among health care professionals has mandated a flexible approach to BLS course content. The traditional line between BLS and ACLS skills has become less well defined with the increase in intubation by emergency medical technicians (EMTs), emergency medical technician–defibrillation (EMT-D) programs, and the use of one-way valve masks. Modular programming allowing the introduction of some of these advances into BLS programs is encouraged for specific audiences.

Education in Pediatric BLS

The public should also be educated in pediatric BLS. Programs in pediatric BLS should be targeted to caretakers of children, including parents, teachers, babysitters, day-care workers, and in some cases siblings. Most cases of non–injury-related cardiopulmonary arrest occur in infants and children with known problems, such as chronic airway disease or congenital heart disease. Infants and children at risk for cardiopulmonary arrest should be identified by the health professionals caring for them, and their families should be trained in CPR. Persons caring for these children must be educated to recognize airway or circulatory problems and taught how to intervene appropriately and gain access to help in emergencies.

Pediatric BLS should be taught in all communities. School-age children should be included in this educational process: children in middle school can successfully perform CPR.[137,138] The pediatric BLS program for the lay public should stress injury prevention, CPR training, and heart-healthy living.

Like adult programs in BLS, pediatric educational programs should be simplified to promote retention of skills. Methods of teaching BLS skills must be evaluated and a strategy developed for simplifying the sequence. Intensive testing of skills with strict performance standards is a barrier to learning and should be avoided. To facilitate retention of knowledge and skills, learning activities that can be done at home should be encouraged. These might include having parents survey their homes using hazard checklists, review CPR techniques using written materials or videotapes, and practice CPR.

Education in Pediatric ALS

The pediatric ALS course is targeted to all health care professionals who treat pediatric patients in acute care settings.[139] Although the pediatric ALS curriculum does not specifically address needs of prehospital care providers, they may benefit from this material. Having a variety of health care providers, including nurses, physicians, and EMTs, work together in small group sessions promotes team building and a better understanding of the role of each member of the resuscitation team.

Education in Neonatal Life Support

The need for resuscitation of the newborn is frequent. It is estimated that approximately 6% of the 3.8 million babies born annually in the United States require resuscitation. The goal of the neonatal resuscitation program is to facilitate the training of a large number of people so that at least one person trained in neonatal resuscitation can be present at every delivery.[140]

Education in ACLS

The goal of the education program in ACLS is to train health care professionals who play a role in the treatment of

the person at risk for cardiac arrest or who has had a cardiac arrest.[141] Although the course focuses on adult cardiac arrest from ventricular fibrillation, it also includes knowledge and psychomotor skills to help the learner treat other forms of cardiac and respiratory arrest as well as other conditions of near-arrest and the period of stabilization after a cardiac arrest. Flexibility in the ACLS course design is strongly encouraged so that the needs of all participants can be met. The lectures, teaching stations, and discussion groups can be designed to meet the needs of novice or more expert participants. The duration of the course should be tailored to meet the needs of learners.

Within 1 year after completing the ACLS course, rescuers have difficulty recalling knowledge and performing ACLS skills.[142-144] If rescuers do not use or practice these skills, performance may deteriorate more rapidly.[145] It is unclear if this is due to problems with the course or with retention capabilities.[142,143] To maintain proficiency in resuscitation, regular refresher courses should be provided. These might include a review of resuscitation decision making, such as choice of drugs for specific problems, and practice of specific skills, such as endotracheal intubation. The individual's scope of practice and use of resuscitation skills should determine the frequency of retraining.

Evaluation: A Process to Improve Learning

Diverse methods of evaluating courses and programs have developed during the past 20 years. Several evaluation models have been described.[146] Of greatest interest are evaluation studies designed to assess and improve the worth of educational programs. The evaluations used for the ECC program have traditionally assessed the effect of education on the learner.[147] Programs should also be evaluated for their effect on outcomes of resuscitation.

Participant evaluation (or "testing") must be consistent with the purpose of the course: education. Evaluation serves multiple purposes: to determine what the participant has learned, to identify problem areas requiring more work, and to provide the course director and instructors with an assessment of the course. If courses are designed and conducted according to the needs of learners and their anticipated use of the information, then participants should attain the targeted knowledge and skills. Evaluation should be used as feedback for learners, course directors, and instructors. If many learners perform poorly, the course director and faculty should determine why.

Directions for Change in the Evaluation Process

Individuals should be allowed to learn to their desired level of performance and at their own pace. Participant differences can be acknowledged so that those who perform satisfactorily can move quickly through evaluation whereas those who need additional assistance can take needed time to improve their performance.

The written examination should also be viewed as an evaluation tool. Review of the examination in small interactive sessions can reinforce important points. Participants can spend time to learn without embarrassment or threat of failure. Even those with satisfactory performance on the written examination and the evaluation stations can benefit from further reinforcement in this process.

There is a critical need for program evaluation in adult, pediatric, and neonatal resuscitation. A national database should be developed on the demographic characteristics of those taking these courses. Affiliates, franchises, organizations, and institutions providing life support education should participate in data collection for program evaluation. Studies must be performed to determine how different educational interventions affect the retention of knowledge and skills, change attitudes, and instill confidence in learners. In BLS, for example, information must be sought to determine if persons who take the courses actually perform CPR, on whom they perform CPR, and what outcomes result from these interventions. Collection of this information has begun in Europe; this will facilitate the formulation of strategies for effective CPR training.[148,149] Only with thorough evaluation can future educational strategies be scientifically and rationally planned.

ROLE OF THE AHA

In 1963 the AHA established a Committee on Cardiopulmonary Resuscitation. It was expanded in 1971 to include ECC and became the Subcommittee on Emergency Cardiac Care. In 1989 it was further expanded and became the Committee on Emergency Cardiac Care with subcommittees on BLS, ACLS, and pediatric resuscitation.

ECC will continue to be a responsibility of the AHA as long as sudden death continues to be a societal problem. ECC includes the three major areas of AHA programming: public education, professional education, and community programs. Since the AHA has both the expertise and community involvement to evaluate such programs effectively, it must continue to bear the ultimate responsibility for monitoring and evaluating teaching and performance standards in ECC as outlined in the 1986 "Standards and Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC)."[3]

MOVEMENT TOWARD INTERNATIONAL GUIDELINES

Almost one of four people who attended the 1992 national conference came from outside the United States. The conference addressed three issues in international ECC: (1) the desirability of international support for countries to develop effective ECC, (2) creating a permanent infrastructure for international cooperation, and (3) common international guidelines and an international conference on CPR and ECC.

International Support for Countries to Develop Programs in CPR and ECC

The AHA has helped colleagues in other countries develop programs in CPR and ECC. Many participants from other countries expressed their appreciation of this help. Others expressed concerns because other health issues in developing countries often have a higher priority than CPR and ECC. Nevertheless, there was general agreement that improvement in many areas of ECC is appropriate for all countries. Unnecessary infant deaths, for example, could be prevented easily and inexpensively by preventive and simple resuscitative measures. Other organizations should assist in providing help to developing countries. A strong infrastructure, however, such as that supporting the AHA, is needed to plan, coordinate, and provide international assistance.

The conference concluded that (1) existing organizations should continue to offer assistance to countries that lack resuscitation programs; (2) help for developing countries in particular should be seen not only as desirable but also as a duty; (3) adequate liaison with those who are best informed within recipient countries should be used to tailor assistance to their requirements; and (4) "first-world" solutions should not be inappropriately imposed on the problems of developing countries. While this message is not new, it is worthy of continued emphasis.

A Permanent Infrastructure for International Cooperation With International Guidelines

The 1992 national conference provided an excellent example of international cooperation, with representatives from 58 countries and most world organizations with an interest in resuscitation. The conference unanimously endorsed the intention to maintain and develop international cooperation in promoting the skills of resuscitation. Existing organizations, however, wished to maintain their autonomy in updating guidelines for CPR and ECC. Furthermore, it was not considered realistic or desirable to introduce a new international conference in the absence of a strong supporting infrastructure. The conference recognized the ambivalence of this position: a determination to preserve existing arrangements was accompanied by a desire to more effectively share the data and expertise that exist around the world.

The conference recommended that the existing major organizations with a responsibility for guidelines in CPR and ECC aim to synchronize their review of guidelines, with the objective of publishing updates in the same year. With such a schedule, the organizations could create international working groups with a worldwide membership of the principal experts in their fields. These groups could offer international reviews of the literature and, based on the shared science and experiences, could make suggestions for modifications in guidelines. These proposed modifications, supported by the science that generated them, would be offered as evidence to the major international organizations for their own meetings and deliberations: to the AHA, the Canadian Heart and Stroke Foundation, the European Resuscitation Council, and associations or societies in Latin America, Australia, Africa, and Asia, ie, to all countries or multinational organizations that might wish to participate. The proposed modifications would be considered by these organizations. If the science was unassailable, the modifications would likely be adopted with or without change, taking into consideration local needs and realities.

Such a plan for international cooperation would have appreciable advantages over existing arrangements: (1) the world's leading experts would achieve fruitful communication and cooperation; (2) advice for guidelines would be less likely to be tainted by habit, tradition, or peer pressure; (3) guidelines generated in this way should be widely accepted within existing organizations; (4) a great similarity (or even identity) of guidelines would likely be achieved without the fear that one group was being subverted by another; (5) the potential would exist for eventual universal guidelines; and (6) existing organizations would not perceive a risk to their independence or autonomy.

IMPLEMENTATION OF CONFERENCE RECOMMENDATIONS

There are important new recommendations for changes arising from the 1992 conference. Such changes take time. None of the 1985 recommendations that have been changed or deleted here are thought to constitute a public health hazard; they have been changed or withdrawn for other reasons described in this document. These changes should be implemented only when the appropriate agencies have instituted orderly plans to do so. Such plans should minimize confusion among the agencies, their instructors, and their professional and lay students.

To ensure maximum effectiveness, these recommendations should be adopted and implemented by the following: (1) state regulatory bodies responsible for EMS systems and health care equipment; (2) professional medical and allied health associations, issuing statements jointly or individually for maximum dissemination, to ensure uniformity in their application and to protect those who are in accordance with them and the emergency victim; (3) the AHA, by taking steps to disseminate these recommendations widely, including programs, training materials, and publications, and by seeking support for dissemination from appropriate foundations, federal agencies, medical organizations, and other appropriate sources; (4) the American Red Cross and other agencies charged with the responsibility of providing training to the lay public; (5) appropriate government agencies; (6) other responsible agencies and organizations, including medical, dental, and nursing schools, secondary schools and colleges, airlines, industries, and sports centers; (7) all emergency medical care units; and (8) all county, state, and national medical organizations, by establishing a mechanism to approve CPR courses given in accordance with AHA recommendations and by instructors trained in accordance with AHA materials.

SPECIAL RECOMMENDATIONS FOR FACILITIES WITH CAPTIVE POPULATIONS

The need for immediately available BLS and rapidly available defibrillation and ACLS places an obligation on those responsible for facilities with large captive populations. Managers of factories, schools, office buildings, apartment buildings, stadiums, large fairs, and the like, should be encouraged to train security and other personnel in the techniques of CPR and the use of the automated external defibrillator. BLS training, ACLS capability, and early ACLS can be relatively inexpensive. Investigation of EMS capabilities in the immediate area of the facility may provide an acceptable solution without additional expense.

RECOMMENDED CHANGES IN THE GUIDELINES

A strong consensus was reached at the 1992 conference for several major changes in the guidelines for CPR and ECC. Most of the 1985 guidelines remain unaltered or have simply been refined. The remainder of this document presents an in-depth discussion of the changes in recommendations and of those recommendations not changed. The reasons for the recommendations and the scientific evidence are discussed. Among the new recommendations, which include major changes from prior recommendations, are the following:

1. The imperative to access EMS promptly leads to a Class I recommendation to telephone EMS (usually 911), whenever

possible, as a first step in the adult BLS protocol when witnessing a collapse or coming across an unresponsive victim. However, in the pediatric age group, 1 minute of CPR is still recommended after initial assessment and before breaking to call EMS. This recommendation results from the knowledge that ventricular fibrillation is unusual in children. Thus, ventilation is more likely to be needed than defibrillation in the pediatric age group. Obviously, shouting for help should occur immediately after the initial assessment.

2. The time taken during ventilation for filling of the lungs in the adult is increased to 1½ to 2 seconds per breath to further decrease the likelihood of gastric insufflation. In infants and children, where small tidal volumes are required and ventilatory rates are faster, the time is unchanged at 1 to 1½ seconds per breath.

3. The unresponsive victim with spontaneous respirations should be placed in the "recovery position" if no cervical trauma is suspected. Placement in the recovery position consists of rolling the victim onto his or her side to help protect the airway.

4. The entry of the second rescuer, for BLS resuscitation, is considerably simplified.

5. Instructors in BLS need to be familiar with and able to teach mouth-to–barrier device ventilation.

6. Esophageal obturator airway, esophageal gastric tube airway, combination esophageal-tracheal tube, and pharyngotracheal lumen airway are classified as Class IIb.

7. The initial dose of epinephrine for the pulseless victim remains unchanged since data concerning high-dose epinephrine do not convincingly establish its superiority. For repeat doses, high-dose epinephrine (up to 0.1 mg/kg) is given a Class IIb status (efficacy uncertain but possibly effective). It may be considered if the standard dose does not lead to the return of a perfusing rhythm. In pediatric life support, the repeat dose of epinephrine at 0.1 to 0.2 mg/kg is Class IIa (probably effective) because there is some evidence of improved outcome with high-dose epinephrine.

8. Sodium bicarbonate remains a drug with variable indications. In hyperkalemia it is a Class I drug; in some situations it is a Class IIa drug (eg, bicarbonate-responsive metabolic acidosis); in other situations it is Class IIb (eg, on return of spontaneous circulation after long arrest intervals); in the majority of arrest cases (hypoxic lactic acidosis) it is considered Class III and is not recommended.

9. Calcium is not routinely recommended (Class III) except under certain circumstances, such as calcium channel blocker overdose or known ionized hypocalcemia, when its use is probably effective (Class IIa).

10. Adenosine is recommended as a Class I agent, the drug of choice, for paroxysmal supraventricular tachycardia in adults.

11. New detailed treatment protocols are presented for bradycardias, tachycardias, pulseless electrical activity, shock and hypotension, acute pulmonary edema, refractory ventricular fibrillation, and hypothermia.

12. The need to use higher doses of drugs in larger volumes for endotracheal administration is emphasized.

13. The value of an intravenous flush to ensure delivery of intravenous drugs into the central circulation is emphasized.

14. The value of the intraosseous route for emergency venous access in infants and children up to 6 years of age is emphasized.

15. Glucose-containing fluids are discouraged for resuscitative efforts because of their possible deleterious effects on cerebral preservation.

16. Thrombolytic agents are considered Class I drugs for acute MI and should be administered early by the first physician who is competent in making the diagnosis.

17. The educational aspects of the ECC programs are discussed and recommendations for changes made.

18. New material on the early diagnosis and management of stroke has been added because of the magnitude of this problem and because of the importance of proper early diagnosis and treatment.

19. The need is recognized to establish policies for advance directives (ie, living wills) and do-not-resuscitate orders. Recommendations are made to assist EMS systems in responding to such orders and advance directives.

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Part II

Adult Basic Life Support

BASIC life support (BLS) is the phase of emergency cardiac care (ECC) that (1) prevents respiratory or circulatory arrest or insufficiency through prompt recognition and intervention or (2) supports the ventilation of a victim of respiratory arrest with rescue breathing or the ventilation and circulation of a victim of cardiac arrest with cardiopulmonary resuscitation (CPR). The major objective of performing rescue breathing or CPR is to provide oxygen to the brain and heart until appropriate, definitive medical treatment (advanced cardiac life support [ACLS]) can restore normal heart and ventilatory action. The prompt administration of BLS is the key to success. In respiratory arrest, the survival rate may be very high if airway control and rescue breathing are started promptly.[1] For cardiac arrest the highest hospital discharge rate has been achieved in patients in whom CPR was initiated within 4 minutes of arrest and ACLS within 8 minutes.[2] Early bystander rescue breathing or CPR intervention and fast emergency medical services (EMS) response are therefore essential in improving survival rates[3,4] and good neurological recovery rates.[5]

BLS includes the teaching of primary and secondary prevention. The basic concept, presented by the American Heart Association (AHA) during the last 20 years, that it is possible to prevent and control coronary heart disease,[6] should be reinforced during the teaching of BLS, with an emphasis on prudent heart living and risk factor modification. The earlier this information is transmitted to the community, the stronger the impact on mortality and morbidity.[7] Therefore, efforts should be made to teach BLS in the schools. Training in CPR should include information on danger signals, actions for survival, and entry into the EMS system to help prevent sudden death following myocardial infarction. For the purposes of the discussion that follows, an "adult" is defined as anyone over 8 years of age. Specific pediatric and neonatal issues are discussed in Parts V through VII.

CITIZEN RESPONSE TO CARDIOPULMONARY EMERGENCIES

Previous guidelines have called for a single rescuer who is alone to perform CPR for 1 minute and then call the EMS system. Anecdotal evidence, however, suggests that trained single rescuers often perform much more than 1 minute of CPR, thereby delaying the call to an EMS system and ACLS care. In addition, witnesses of a collapse may call neighbors, relatives, or family physicians before activating the EMS system, further delaying defibrillation and decreasing the opportunity for survival from sudden cardiac arrest.[8,9] Recent studies of early defibrillation and EMS activation have demonstrated a need to change this guideline.[10]

The majority of adults (80% to 90%) with sudden, nontraumatic cardiac arrest are found to be in ventricular fibrillation when the initial electrocardiogram (ECG) is obtained.[11] For these victims early defibrillation coupled with early bystander CPR has been shown to significantly increase the chance of survival.[11,12] The time from collapse to defibrillation is critical. Most survivors of ventricular fibrillation received early defibrillation.[12] The benefit of early defibrillation is demonstrated by the improved survival rates in communities that have initiated an emergency medical technician-defibrillation (EMT-D) program.[4]

The window of opportunity for survival from sudden cardiac arrest is very narrow.[8] Structured EMS systems that can be accessed quickly by telephoning 911 (or another easily remembered number) have recently been shown to improve survival from sudden cardiac death.[13] Because of these compelling data in adult victims, both trained and untrained bystanders should be instructed to call 911 or local emergency telephone numbers as soon as they have determined that an adult victim is unresponsive.

A potential concern about activating the EMS system before full assessment (by the single trained rescuer) is the delay incurred in treating the patient with primary respiratory arrest or an obstructed airway. In many adult patients with primary respiratory compromise—such as asphyxiation, drowning, strangulation, respiratory arrest due to epileptic seizures, drug overdoses, or obstructed airway—airway opening and rescue breathing are indicated, not chest compression or defibrillation. However, even trained rescuers may be unable to distinguish between primary cardiac arrest and a collapse secondary to airway and breathing problems.[14] In addition, the vast majority of sudden death victims will not have a primary obstructed airway. More than 80% of such victims of out-of-hospital cardiac arrest will be in ventricular fibrillation, and defibrillation is the key to survival in such patients. Hence, for all adult patients, activating the EMS system immediately after determining unresponsiveness is justified.

When the emergency involves an infant (aged less than 1 year) or child (aged 1 to 8 years) instead of an adult (aged more than 8 years), an airway problem is the most likely cause of distress or collapse.[15] In such situations rescue support is essential and should be attempted first if the rescuer is trained and can perform the appropriate technique.[10] If an apparent foreign-body airway obstruction is present in either a conscious adult or child and the trained rescuer knows and can perform the proper technique, the Heimlich maneuver should be attempted before activating the EMS system.[10] If the rescuer is untrained, the EMS system should be activated immediately. For adult victims of cardiac arrest, if two bystanders are present, one should determine unresponsiveness and activate the EMS system, and the other should begin CPR. Emergency medical dispatchers (EMDs) will need to know that the victim is unresponsive or that CPR is in progress in order to dispatch the appropriate rescue personnel and vehicle. EMDs have been identified as a vital but often neglected part of the EMS system. All communities should provide formal training in emergency medical dispatch and require the use of medical dispatch protocols, including prearrival instructions for airway control, foreign-