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Lay rescuer automated external defibrillator programs for children and adolescents

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In the early 1990s, the American Heart Association (AHA) launched the public health initiative, public access defibrillation [1,2]. The goal of this initiative was to improve the 6.7% nationwide average survival rate of out-of-hospital sudden cardiac arrest (SCA) [3] in adults by placing automated external defibrillators (AEDs) throughout communities and training lay rescuers in cardiopulmonary resuscitation (CPR) and the use of AEDs. Lay rescuer AED programs that were established in airports [4] and casinos [5] and by police officers [6–8] documented 49% to 74% survival rates from sudden witnessed ventricular fibrillation (VF) cardiac arrest in adults.

In recent years, the lay press has documented episodes of sudden death among young athletes, with several deaths caused by SCA. This stimulated grassroots support for the establishment of lay rescuer AED programs that are aimed at a younger population—primarily children and adolescents. Specific efforts have focused on establishment of these programs within schools.

In January of 2004, the AHA introduced a new public health initiative, the Medical Emergency Response Plan for Schools [9]. This initiative is endorsed by several health and professional organizations, including the American Academy of Pediatrics, the American College of Emergency Physicians, the National

Dr. Berger is the Director of Project ADAM and Ms. Utech is the Project Coordinator. The Project receives funds from foundations that are supported by defibrillation manufacturers. Ms. Hazinski is a compensated consultant for the American Heart Association and serves as the Senior Science Editor for the AHA Emergency Cardiovascular Care Programs. Ms. Hazinski served as Principal Investigator for a research project regarding the sensitivity and specificity of Physio-Control automated external defibrillators. She received no salary support for this project. Dr. Berger and Ms. Hazinski are authors of the AHA Statement regarding the Medical Emergency Response Plan for Schools.

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Association of School Nurses, and the American National Red Cross. The initiative encourages schools to develop and practice plans to respond to life-threatening medical emergencies, including SCA by training and equipping lay rescuers to provide first aid and CPR. The initiative recommends the establishment of AED programs in schools that have an established need [9].

This article summarizes the controversies regarding the establishment of lay rescuer AED programs in schools. It describes the elements of one successful program and provides recommendations for critical elements of AED programs in schools, using the recommendations that were described by the AHA statement and experience gained in the establishment of AED programs in high schools in Wisconsin.

The American Heart Association recommendations regarding the Medical Emergency Response Plans for Schools

The AHA and organizations that endorse the medical emergency response plan for schools recommend five core elements of a school medical emergency response plan [9].

Effective and efficient communication throughout the school campus

The communication should link all parts of the school campus, including outdoor buildings and practice fields. This communication can use cellular phones, walkie-talkies, intercoms, and alarms to enable school personnel and students to activate the Emergency medical services (EMS) system immediately when an emergency occurs. Valuable time is lost if a teacher must send a runner from a practice field or outlying building.

Coordinated and practiced response plan

Each school should develop a response plan with participation of the school nurse, the school or athletic team physicians, athletic trainers, and the local EMS agency, as appropriate. The school staff and students should practice the response sequence at the beginning of each school year and periodically throughout the year. EMS personnel may be willing to make a preincident visit to the school to identify any potential problems with EMS access to all locations on the school campus and may participate in practice drills.

Risk reduction

The school should initiate safety precautions to prevent injuries on playgrounds and in classrooms. In addition, the plan should identify any school staff

or students who have medical conditions that may create a risk of SCA and reduce that risk when possible.

Training and equipment for first aid and cardiopulmonary resuscitation

Training is a critical component of preparation for a medical emergency. A school survey in New Mexico found that 67% of schools activated the EMS system for a student and 37% activated it for an adult in the preceding year [10]. In a statewide survey of EMS calls for children in Utah, two thirds of calls to schools were for injuries and one fourth were required for medical complaints, such as breathing difficulties or seizures [11]. Eighteen percent of surveyed teachers in a Midwest study provided some emergency care to more than 20 students each year and 17% had responded to one or more life-threatening events in their careers [12]. One third of teachers surveyed had no training in CPR and 40% had never completed a CPR course [12]. The AHA statement recommends that several teachers should be trained and equipped as CPR and first aid instructors. This ensures that the teachers are prepared to respond to any life-threatening medical emergency that occurs at the school and enables the teachers to teach CPR to all high school students.

Implementation of a lay rescuer automated external defibrillator program in schools with an established need

The AHA statement cites the recommendation that was contained in the 2000 International Guidelines for CPR and emergency cardiovascular care (ECC) regarding establishment of lay rescuer AED programs [13]. These guidelines suggest consideration of AED program implementation in locations with at least one of the following characteristics:

A reasonable probability of the AED use within 5 years of rescuer training or an AED use or an episode of SCA has occurred within the previous 5 years, or

There are children or adults at the school who are believed to be at high risk for SCA, or

An EMS call-to-shock interval of less than 5 minutes cannot be achieved reliably with conventional EMS services and a collapse-to-shock interval of less than 5 minutes can be achieved reliably (in $>90\%$ of cases) by training and equipping lay persons to function as first responders

The AHA recommends five critical elements for successful lay rescuer AED programs:

Medical/health care provider oversight

Training of anticipated rescuers in CPR and use of an AED

Coordination with the EMS system

Appropriate device maintenance

Ongoing quality improvement program

For further information about the Medical Emergency Response Plan for Schools statement and for additional links to implementation resources, the

reader is referred to the AHA website: http://www.americanheart.org/presenter.jhtml?identifier=3017969.

Sudden cardiac arrest in southeastern Wisconsin

In the years 2000 through 2002, southeastern Wisconsin had an average population of 2.02 million people, with an average of 986,055 people who were younger than 35 years of age and an average population of 552,445 people who were between the ages of 15 and 34 years [14]. In the 4-year period from January, 1999 through January, 2003 we documented 18 episodes of unexpected SCA in previously asymptomatic children and adolescents aged 12 to 25 years. This average of 4.5 episodes of SCA per year represents an incidence of 0.8 deaths per 100,000 people per year. This number of SCAs is at the higher end of the 0.5 to 1 case/100,000 population per year incidence that is reported commonly in the literature for people who are younger than 35 years of age. The age range of 12 to 25 years in our population of patients is a bit different than the age range of 15 to 35 years that was used for comparison. If anything, it would be expected that the range used as comparison should have a moderately larger frequency because of the extension into the 25- to 35-year-old age range.

On the basis of a statewide survey in Minnesota, Maron et al [15] estimated the incidence of SCA to be 0.5 to 1 case/100,000 high school athletes per year. Voluntary reports of traumatic (caused by commotio cordis) and nontraumatic cardiac arrest among high school and college athletes that were gathered from 1983 to 1993 by the National Center for Catastrophic Sports Injury Research (NCCSIR) documented an average of 16 sudden cardiac deaths per year nationwide. In the NCCSIR data, the incidence of SCA was higher in male athletes (0.75 per 100,000) compared with female athletes (0.13 per 100,000) athletes and in male college athletes (1.45 per 100,000) than in male high school athletes (0.66 per 100,000) [16,17].

Table 1 lists the causes of SCA in the 18 victims from southeastern Wisconsin. There were 7 survivors, for a survival rate of 38.9%. The 7 survivors had

Table 1
The experience with sudden cardiac death in children and adolescents in southeastern Wisconsin January 1999 to January 2003

Total episodes of sudden cardiac arrest	18
Death	11
Hypertrophic cardiomyopathy	8
Left coronary from right sinus of Valsalva	2
Right ventricular dysplasia	1
Survival	7
Hypertrophic cardiomyopathy	1
Long QT syndrome	5
Left coronary from right sinus of Valsalva	1

Table 2
Sudden cardiac death in southeastern Wisconsin: diagnoses, ages, outcomes

Cardiovascular problem	Age (y)	Outcome
Hypertrophic cardiomyopathy	17	Died
Hypertrophic cardiomyopathy	15	Died
Hypertrophic cardiomyopathy	18	Died
Hypertrophic cardiomyopathy	15	Died
Hypertrophic cardiomyopathy	16	Died
Hypertrophic cardiomyopathy	14	Died
Hypertrophic cardiomyopathy	16	Died
Hypertrophic cardiomyopathy	22	Died
Hypertrophic cardiomyopathy	20	Survived
Left coronary artery from the right sinus of Valsalva	18	Died
Left coronary artery from the right sinus of Valsalva	15	Died
Left coronary artery from the right sinus of Valsalva	14	Survived
Long QT syndrome	14	Survived
Long QT syndrome	14	Survived
Long QT syndrome	12	Survived
Long QT syndrome	14	Survived
Long QT syndrome	14	Survived
Arrhythmogenic right ventricular dysplasia	17	Died
	Range: 12–22 y	7/18 survived
	Average: 15.8 y	38.9% survival
	Median: 15 y	

documented VF and all had immediate CPR and defibrillation within 5 minutes of the event. Table 2 lists the diagnoses, ages, and outcomes of each of the 18 children and adolescents who experienced SCA. The publicity that was generated by the tragic deaths of 11 young athletes and the documented success of rescue efforts for 7 of the victims stimulated the establishment of Project ADAM (Automated Defibrillators in Adam's Memory).

Project ADAM

Project ADAM was initiated in November 1999. It was named after Adam Lemel, a 17-year-old student athlete who died in January 1999 during a high school basketball game. The goals of Project ADAM are: (1) education of school staff, parents, and students, the lay-public and health care professionals about SCA in children and adolescents; (2) advocacy for teaching CPR, the use of an AED, and emergency response to all high school students before graduation; and (3) placement of AEDs in all high schools in the state of Wisconsin. The emphasis of Project ADAM has been to provide information, develop educational tools, and provide on-site consultation and support so that any school that is interested in an AED program can be given all of the information that is necessary for the establishment and continuation of such a program.

Project ADAM provides school personnel, parents, students, and health care professionals with information about the risk factors for, and the warning signs

of, cardiac arrest. This education focuses on elements of family history that may increase the risk of SCA and indications for expanded screening of an athlete. Project ADAM support material includes an educational video that shows an actor simulating symptoms and warning signs that can precede SCA [18]. The video also summarizes symptoms and warning signs that will help to identify children who have conditions that may increase their risk for SCA. After watching the video, teachers, coaching staff, and health care providers should be more qualified to identify significant warning signs and symptoms that are associated with SCA in young children, particularly young athletes.

Project ADAM emphasizes the need for training all high school students to respond quickly and effectively to any emergency situation. Project ADAM encourages schools to teach CPR to all graduating seniors. This may save lives in the high school and will increase the number of trained rescuers throughout the community. It prepares students to respond to SCA in the home, the site of two thirds of the out-of-hospital episodes of SCA [19].

Project ADAM staff is available to provide practical support to help schools establish lay rescuer AED programs. The staff performs an initial consultation with an educational needs assessment and then helps each school to design a program for the school. The staff distribute a Project ADAM manual, a CD-ROM, a video, and program templates that describe a step-by-step approach to program implementation.

A member of the Project ADAM staff can serve as medical director for each school lay rescuer AED program. After schools identify a program coordinator, Project ADAM staff can help the coordinator to establish working groups at each involved school. These working groups assist with development of a budget and project costs that are necessary to implement the program and help to identify volunteers to complete project tasks.

The Project ADAM team pursues funding opportunities to pay for the program and is available to advise schools regarding decisions, such as AED selection and placement. Staff will assist schools in choosing a training organization or in developing CPR instructors to become independent in training. Project staff also assist in coordination with the local EMS providers and identification of their level of licensure and response capabilities, follow-up, review sessions, data collection, and reporting.

Project ADAM has been able to support the establishment of AED programs in 143 of the 400 public high schools in the state of Wisconsin. Wisconsin schools have chosen to do this without any state legislative requirement.

Project ADAM also helps the schools to identify how they can play a key role within the community. The schools can participate in cooperative fund-raising initiatives that help to establish AED programs in each community. Project ADAM encourages schools to ensure that all first responder vehicles are equipped with AEDs and that all first responders, including police, are trained and equipped to perform CPR and early defibrillation. This collaborative approach enables all community members to design similar programs that will make it easy to respond to any event, regardless of where it occurs in the community.

Project ADAM has also distributed the "how-to" Project ADAM program materials throughout the country. There have been more than 500 inquiries for this program materials. More information about Project ADAM is available on the website at: http://healthlink.mcw.edu/article/962141848.html.

Controversies regarding lay rescuer programs for children and adolescents

There have been many questions and concerns expressed about the establishment of lay rescuer AED programs that target children and adolescents, particularly those that are established in schools. Issues of controversy include cost and cost-effectiveness, AED device placement, safety of the devices, and potential liability of AED programs. Each of these issues is addressed.

Cost

The AHA statement regarding the Medical Emergency Response Plan for Schools lists potential and start-up costs for a high school response plan that includes a lay rescuer AED program. Costs are calculated for a high school with an average of 390 students. The costs projected in the AHA statement are listed in Table 3 and include the costs of educating four teachers as CPR, AED, and first-aid instructors; educating half of the student body in CPR every year; purchase of

Table 3
Potential costs of high school medical emergency response plan with lay rescuer AED program

Implementation item and quantity needed	Cost	Projected lifespan	Annual cost to school (including 3% annual depreciation)
Training 4 teachers as CPR and first aid instructors with course costs (4 @ $300)	$1200	2 years	$627
Substitute teachers (4 @ $250)	$1000	2 years	$523
AED with equipment	$2500	8 years	$356
Manikins (8 @ $175) and AED trainers (8 @ $100)	$2200	6 years	$388
First aid kit	$300	10 years with some items replaced every year	$185
Training materials for students, including barrier devices, books, cards	$865	Variable lifespan	$986
Totals	$7965 startup		$3065

Data from Hazinski MF, Markenson DS, Neish S, et al. Response to cardiac arrest and selected life-threatening medical emergencies; the Medical Emergency Response Plan for Schools. Circulation 2004;109:287.

an AED, AED supplies, and first aid supplies; and purchase of manikins and training materials.

Project ADAM recommends the individual tailoring of teacher and student CPR training, based on the size and resources of the school. Schools may choose to secure training from an outside organization to keep start-up costs low. Ultimately, most schools find it more cost effective to send some teachers or staff members to be credentialed as CPR instructors. The AHA School Emergency Response Plan recommends that the teachers be credentialed as CPR and first aid instructors at the same time for approximately the same cost. If the school purchases manikins and other training material, this reduces the costs of student CPR training and allows the school to tailor training and ''refresher'' sessions and practice drills to best fit their needs.

Project ADAM has provided small start-up grants for schools in Wisconsin by working with local philanthropic and service organizations that have provided financial support. Schools and school districts have been creative with their fundraising initiatives from special sporting events to collecting pennies from all students. They have obtained donations from community foundations, students, and parents. No Wisconsin school has failed to implement an AED program because of the inability to get funding.

Automated external defibrillator device placement

AHA guidelines for lay rescuer AED programs recommend that AEDs be placed within a brisk 1- to 1.5-minute walk from any site in the program [13]. If the school campus is large, consists of several buildings, or the athletic teams practice at remote sites, it may be necessary to purchase and place several AEDs on the school property.

Project ADAM recommends that schools develop a multitiered plan to purchase AEDs and implement programs in all school buildings over several years, with priority placement of AEDs in buildings where high-risk students or staff are located. Although this may be viewed as an unequal standard of care, legal experts have advised us that such a plan will be a safeguard against potential litigation.

The importance of involving the local emergency medical services personnel in the early planning stages cannot be overemphasized. Their input will be helpful to optimize the location and implementation of AEDs within the individual school. This information, with the help of the local EMS, can also be transmitted to the dispatch centers. This enables dispatchers to remind a 911 caller that there is an AED on the premises; if the user is untrained, s/he can be ''talked through'' the process by the dispatcher.

Cost effectiveness

One acceptable method of evaluating cost effectiveness is determining the cost per life saved. This requires calculation of the total costs of AED program

implementation in a group of schools and then determining the number of lives that were saved in those schools. Projected costs for establishment of a school medical emergency response plan with an AED program can average $3065 per school per year. If these costs are applied to all high schools nationwide, using the estimated incidence of 0.5 to 1 episode of SCA per 100,000 high school students per year, the projected costs total $1.5 to $3.3 million per life saved [9]. These figures are only estimates because the incidence of SCA in children is unknown. SCA is not a cause of death that is reportable to the National Center for Health Statistics for any age.

Approximately 4% to 10% of all pediatric victims of cardiac arrest in the out-of-hospital setting demonstrate VF when ECG rhythm is assessed [20–22]; this percentage increases to 19% to 24% if victims of sudden infant death syndrome are excluded [22]. Some investigators suggest that emphasis on support of airway and breathing in the first minutes of an out-of-hospital pediatric cardiac arrest may lead to late assessment of the victim's rhythm [22,23]. It is conceivable that an initial VF rhythm may deteriorate into a nonshockable asystolic rhythm by the time a child's rhythm is assessed. Losek et al [24] published the only study that documented the initial ECG rhythm of victims of pediatric cardiac arrest at the time of EMS arrival. In that study, which was performed in Milwaukee, the ECG rhythm of 117 victims (newborn to 18 years of age) who were in cardiac arrest was assessed at an average of 6.1 minutes after EMS call. Seven victims (6%) had VF or pulseless ventricular tachycardia (VT) on initial ECG, but only 19% of the arrests were witnessed (81% of the victims were found dead). Of the pediatric victims who had witnessed arrest, 13% had VF or pulseless VT; none of these victims survived (J.D. Losek, MD, personal communication, 2001).

Widespread use of AEDs will enable more data collection about frequency of VF as a terminal rhythm in infants and children in the out-of-hospital setting. It also will enable the collection of outcome data.

Another challenge to the collection of data regarding SCA in the young is that SCA is a random event and random events tend to cluster. The number of deaths that is attributable to SCA in the young varies widely in literature reports and it may vary threefold from year to year in the same community [25]. For this reason, any data about SCA in the community should be collected over several years.

Typically, the survival and neurologic outcome of victims of pediatric cardiac arrest who present with VF or pulseless VT on arrival of EMS personnel is better than the outcome of children who present with bradyasystolic rhythms (eg, 24% survival versus 8.4% survival) [21,22,26]. A child survivor of SCA may live for many productive years. If the AED program costs are calculated per life-year saved, the costs may be low [27]. The effective treatment of VF/VT through early pediatric defibrillation may represent a tremendous "window of opportunity" to improve survival in children.

If the projected annual costs of lay rescuer AED programs are borne by taxpayers, it is legitimate to ask if the establishment of AED programs in schools

will result in the greatest number of lives saved for the investment. If a community must choose between equipping first responders with AEDs that will be used 24 hours a day and 7 days a week and placing AEDs in schools that will be closed and locked 10 hours a day, 2 days a week, and 10 weeks per year, the placement of the AEDs with first responders is likely to save more lives. Because the school often serves as a community gathering place or is the site of large athletic events, adult education, or summer school, the case for an AED program may be stronger. Ideally, AED programs should be established wherever there is a need. When multiple needs are identified, prioritization may be necessary unless funds can be raised from alternative sources or resources are unlimited.

Using the Milwaukee public school system as a prototypic model, an assessment was made of the potential cost-effectiveness of implementing Project ADAM. Data was collected regarding costs of the AED program and episodes of SCA over a 3-year period. Frequencies of SCA for children and adolescents and frequencies of the common abnormalities that are associated with the potential for SCA and the frequencies of SCA in these specific cardiovascular abnormalities were used. Using this analysis, it was determined that at an arbitrary societal willingness to pay $100,000 per life-year saved, the policy to implement Project ADAM in schools is a cost-effective strategy at a threshold of approximately five patients saved over 5 years [28]. By current standards of cost-effectiveness, these results are considered favorable. Because several assumptions have been made in this analysis, further data may be needed to verify some of the numbers in Milwaukee as well as in additional communities.

Safety of automated external defibrillators for use in children

The safety and efficacy of AED use in adults [29] and lay rescuer AED programs for adult victims are well-established [3–8,30–43]. Until recently, however, the accuracy of AEDs in interpreting rhythms was determined using libraries of adult shockable and nonshockable ECG rhythms. In addition, until 2000, all commercially available AEDs delivered adult shock doses. As a result, in 2000, the AHA and the International Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care [13] classified the use of AEDs for children under 8 years of age as an indeterminate recommendation, indicating that there was insufficient data to recommend for or against the use of these devices for children.

From 2000 to 2003 there were many technologic and scientific advances in AEDs. In 2003, the AHA and the International Liaison Committee on Resuscitation (ILCOR) issued a new recommendation that AEDs could be used, after 1 minute of CPR for children 1 to 8 years of age who were in cardiac arrest in the out-of-hospital setting, with a class II b recommendation [44]. This statement noted that ideally, pediatric pad-cable systems should be used and the AED should be documented to have high sensitivity and specificity for pediatric rhythms.

The AHA and ILCOR indicated that there was insufficient evidence to recommend for or against the use of AEDs in infants (class indeterminate recommendation) [44]. AEDs do require several seconds to analyze a victim's rhythm and two to three periods of analysis may be required to determine if the victim's rhythm requires shock delivery. "Clearing" the victim for rhythm analysis could result in frequent and prolonged interruption of ventilation and compressions in an infant who may have a low probability of VF. The AHA/ILCOR statement cited the need for more data about the relative frequency of respiratory versus SCA and more data about the effects of high defibrillation doses in infants.

Human studies documented the accuracy (sensitivity and specificity) of two commercially-available AEDs in interpreting pediatric rhythms [45,46]. The two AEDs that were studied were accurate over a wide range of pediatric heart rates and rhythms, and in infants and children, were verified against three-lead ECG rhythm analysis by clinical experts [45,46].

In the past 3 years, the U.S. Food and Drug Administration has cleared three AED pad-cable systems that attenuate the dose that is delivered by three commercially-available AEDs to approximately one third to one fourth of the adult dose. These reduced-dose AEDs are the systems that are recommended for use in children [45].

Project ADAM recommends that schools purchase biphasic AEDs that have been proven to be accurate in interpreting pediatric rhythms and that can be used with pediatric or adult pad-cable systems. In recent years, biphasic waveform AEDs have been shown to defibrillate effectively with smaller doses than those that are required with monophasic defibrillator waveforms; biphasic waveform defibrillators also were shown to produce less myocardial damage [44]. Thus, biphasic waveform defibrillators are believed to be effective for the treatment of a wide range of victims. Schools should stock adult and child pad-cable systems so the AED will be able to be used on a wide variety of victims.

Liability

School personnel and community leaders often express concern about school liability for AED programs. All 50 states have passed legislation or regulations that extend Good Samaritan limited immunity to lay rescuers who, without specific compensation, use an AED in a good faith effort to save a life. Most of these laws or regulations stipulate that the AED program should train anticipated users, but most do not preclude limited immunity for serendipitous rescuers (those who happen upon the scene and act). Wisconsin Act 7 is an example of this legislative requirement [47].

In November 2000, the Cardiac Arrest Survival Act (CASA) was passed and signed into federal law (PL 106-505) [48]. This law calls for the development of guidelines for the establishment of lay rescuer AED programs in federal buildings. In addition, it provides limited immunity for anyone who attempts to use an AED for a victim of perceived medical emergency. It also provides limited

immunity for ''any person who acquired the device,'' if the AED acquirer does the following:

Notifies local emergency response personnel or other appropriate entities of the placement of the AED within a reasonable period of time
Properly maintains and tests the device
Provides appropriate training in the use of the device to expected users (note the stipulation for training of expected users rather than all users)

Because the CASA is federal legislation it ''supercedes the law of a state'' if the state ''has no statute or regulations that provide persons with such class with immunity for. . .the use. . .of automated external defibrillator devices in emergency situations'' [48]. In practice, the Act filled in the gap in liability protection for acquirers in approximately 12 states. The federal CASA provided immunity for the AED user and the AED acquirer if the state had not granted immunity for these roles under other conditions.

Although most states provide limited immunity for Good Samaritan rescuers, the state laws and regulations often provide conditions under which limited immunity applies to AED program enablers, such as the premises owner, the AED purchaser, the physician prescriber, the program coordinator, and the trainers. Most legislation and regulation require that the physician prescriber or program coordinator notify local emergency medical services about the type and location of the AED, train anticipated users in CPR and AED use with a nationally-approved curriculum, and maintain the AED in accordance with manufacturer recommendations. In some states, efforts are being made to specify that training is not required for limited immunity to apply to the premises owner and AED acquirer if a serendipitous rescuer uses the AED.

Several years ago, businesses reported increased cost of building liability insurance when AEDs were placed in a building. Now, many insurance companies offer discounted insurance when an AED program is implemented in a building.

As of the date of this publication, the authors are aware of no litigation for AED purchase or use in the out-of-hospital setting. Several lawsuits have been filed against organizations and businesses that have not established AED programs, however [49].

Legislation and grassroots support for school automated external defibrillator programs

In June 2001, the ADAM Act was introduced by Senators Feingold (Wisconsin) and Collins (Maine) in the U.S. Congress [50]. This bill proposed the funding and establishment of a national clearinghouse for dissemination of information to schools across the United States to facilitate establishment and support of AED programs. This bill passed Congress in June of 2003 and was signed into law by President Bush. Grant funds will be appropriated and

made available to the clearinghouse through the U.S. Department of Health and Human Services.

Many effective AED advocacy groups exist throughout the United States. The Louis Acompura Foundation was established after the death of a young athlete in New York in March of 2000. His death resulted from commotion cordis when he was struck in the chest while playing lacrosse. The Acompura Foundation was instrumental in passage of an unfunded mandate by the New York State Assembly that required AED programs in every school in the state by December, 2002 [51]. Although all New York schools are not yet compliant, efforts are being made to acquire the equipment and training. Pennsylvania and Illinois have similar legislative mandates that affect schools. Legislative initiatives regarding school AED programs are pending in 12 additional states.

The Greg Moyer Foundation in Pennsylvania was established by his parents after he collapsed and died while playing basketball. The Ken Foundation in Ohio was begun by the parents of Ken Derminer after he suffered a SCA event and died while playing basketball. The Kimberly Anne Gillary Foundation was established by her parents after she died while playing water polo. These organizations support efforts to ensure successful resuscitation of children who suffer sudden death. They represent a segment of parents throughout the nation who have been affected by the tragedy of losing a child and have chosen to create something positive as a result of their tragic losses.

Research needed

A great deal of data is needed to enable schools and communities to improve the survival of SCA in children and adults. It is only through the collection of data and the documentation of outcomes that our society can determine the most effective allocation of personnel, training, equipment, and resources to save the greatest number of lives. Several research priorities are presented here.

First, SCA must be listed as a reportable cause of death for all ages. After SCA is listed as a cause of death with the National Center for Health Statistics, communities and funding agencies can monitor the frequency of SCA in each major age group, determine the location of victims of establish programs to treat SCA, and evaluate the effects of treatment programs and protocols on survival of SCA.

Second, schools must document the frequency and outcome of life-threatening emergencies. This data will enable the evaluation of existing teacher and staff support and the best use of school personnel and resources to save the greatest number of lives. Third, data is needed regarding the cost effectiveness of programs, such as school AED programs.

In September 2003, a study that was funded by the AHA, the National Heart, Lung, and Blood Institute (NHLBI), and the defibrillator manufacturers—the Public Access Defibrillation Trail—concluded data collection. This prospective, randomized, controlled clinical study involved 24 field centers in approximately

1000 community units. It was designed to test whether volunteer, nonmedical responders can improve survival of adult out-of-hospital cardiac arrest by using AEDs. All rescuers were trained to recognize adult cardiac emergencies, phone the EMS system (911), and perform CPR. Rescuers in the study group also were trained and equipped to perform early defibrillation with an AED. The primary outcome that was evaluated was the number of adult victims of out-of-hospital cardiac arrest who survived to hospital discharge. Secondary outcomes that were evaluated included neurologic status, health-related quality of life, cost, and cost effectiveness [52]. Final results are expected to be published soon, but preliminary results that were reported at the AHA Scientific Sessions showed that the use of AEDs added to early recognition, early EMS activation, and early CPR and doubled survival when compared with early recognition, early EMS activation, and early CPR without use of AEDs.

Summary

Great interest in school AED programs has developed during the past several years. Experience gained in adult AED programs documents that successful resuscitation from SCA requires more than the purchase of equipment. It requires a planned response that is designed to ensure early recognition of emergencies with early EMS activation, early CPR, and early defibrillation. These actions create the first three links in the AHA adult Chain of Survival. Although SCA is less common in children than in older adults, it is clear that survival of SCA can occur if bystanders are trained and equipped to act. There is rationale for the development of school AED programs as part of an emergency response plan for the school. Such endeavors seem to be cost effective and can and will continue to save the lives of children, adolescents, and adults.

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