Report to the Maryland General Assembly

Regarding the Placement of

Automated External Defibrillators

SB742 (Chapter 349) 2007

The Maryland Institute for Emergency Medical Services Systems (MIEMSS)

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Background

Senate Bill 742 (Chapter 349, 2007) "Swimming Pools – Automated External Defibrillators – Study" required the Maryland Institute for Emergency Medical Services Systems, in consultation with interested stakeholders, to study whether automated external defibrillators (AEDs) should be provided on-site at swimming pools in Maryland and to examine: 1) which swimming pools should be required to provided AEDs; 2) whether the presence of individuals trained in the use of automated external defibrillators should be required by swimming pools; and 3) the safety of providing AEDs at a swimming pool. In addition, the statute required MIEMSS to make recommendations on locations, other than swimming pools, where AEDs should be required.

This report contains information and results from analyses conducted on cardiac arrest data in Maryland. MIEMSS conducted the analyses over the course of several months. Results were reviewed and approved by the AED Task Force at its meeting on November 9, 2007 as well as by the State EMS Board at its November 13, 2007 meeting. A listing of the members of the AED Task Force, as well as other interested individuals who attended AED Task Force meetings in 2007 is included at Appendix A.

Executive Summary

- Sudden cardiac arrest ("SCA") occurs when the heart develops an abnormal rhythm (usually ventricular fibrillation or ventricular tachycardia) which results in a loss of an effective heartbeat and death if not treated rapidly. Maryland has approximately 4,000 SCAs each year.

- The abnormal heart rhythms that most commonly cause SCA are ventricular fibrillation and ventricular tachycardia which frequently occur spontaneously and without warning. The treatment for these abnormal heart rhythms is to shock the heart, a procedure called "defibrillation."

- Defibrillation is most effective if provided within 3 - 5 minutes of SCA and has limited or no effectiveness after 10 minutes.

- Since the early 1990's, there have been increasing calls for placing AEDs in the community for use by lay rescuers, a process referred to as "Public Access Defibrillation" ("PAD").

- The effectiveness of defibrillation in a given PAD program is directly related to the percentage of arrests that are witnessed and how often and how quickly the rescuers are able to obtain, correctly apply, and activate the AED. The cost-effectiveness of a given PAD program is related to a number of factors including the likelihood of a cardiac arrest occurring at the location and the likelihood that the victim will survive.

- A number of resources may be utilized to guide the State in making public policy decisions regarding the response to out of hospital SCA, including National Guidelines, especially from the American Heart Association, published peer reviewed scientific studies, legislative trends in other states, and available data.

- Current American Heart Association guidelines recommend establishment of PAD Programs at locations that are likely to have at least one SCA every 5 years and where the public safety time to defibrillation is greater than 5 minutes. They also recommend PAD Programs at health clubs with > 2500 members and places with a high likelihood of witnessed SCA such as international airports, casinos, and sports facilities.

- A few states have passed legislation in the past several years mandating the establishment of PAD programs at the following locations: schools (10 states); health clubs, fitness centers, health spas, health studios, gyms, weight control studios, and martial arts schools with > 500 members (7 states); and places of public assembly (2 states).

- Maryland Cardiac Arrest Data indicate that the following high-risk locations should have the capability to provide defibrillation within 3 to 5 minutes of SCA through a PAD program, public safety, and/or the availability of AEDs or manual defibrillators for healthcare workers at that location:

    - BWI Marshall Airport (PAD program already in place)

- Skilled nursing facilities
- Dialysis centers
- Racecourses and racetracks
- Enclosed malls
- Hospitals and hospital premises

- Maryland Cardiac Arrest Data, national guidelines, legislative trends and the likelihood of a higher percentage of witnessed SCAs indicate that the following intermediate risk locations be should considered as potential locations for requiring the capability to provide defibrillation within 3 to 5 minutes of SCA through a PAD program and / or public safety:

    - Sports stadiums
    - Rehabilitation facilities
    - Ocean City beaches (PAD program already in place)
    - Amusement parks
    - Public parks
    - Colleges and universities
    - Golf courses
    - Health clubs and related facilities
    - Places of large public assembly
    - Casinos (if established in Maryland)
    - High rise residential facilities and housing complexes with greater than 250 individuals over the age of 50 present for 16 or more hours a day.

- Cost- effectiveness of PAD programs at intermediate risk locations is enhanced when the locations are large/high exposure facilities (e.g. health clubs with more than 500 members (AHA recommends 2500) or educational facilities with over 1000 students, faculty and staff present).

- Requiring AEDs at every swimming pool is not currently supported based on an analysis of national guidelines, legislative trends, and Maryland MCASS data. Voluntary placement of AEDs at swimming pools, especially larger ones, as well as participation in PAD Programs should be encouraged.

- Perceived barriers to participation in PAD Programs should be eliminated.

- MIEMSS should continue to trend data from MCASS, review national recommendations, legislative trends, and published scientific studies and periodically report back to the Legislature as new information becomes available. MIEMSS should also continue to work toward obtaining hospital discharge information as the outcome measure for cardiac arrest; however, this may require additional resources not currently available.

- Consideration should be given to greater investment in public safety AED programs – fire, EMS, and police – that are capable of arriving and defibrillating within 5 minutes of arrest. At the present time, this is the only proven effective approach to addressing SCA in homes which account for the vast majority of SCAs (about 80%).

Introduction

Sudden cardiac arrest ("SCA") occurs when the heart develops an abnormal rhythm (usually ventricular fibrillation or ventricular tachycardia) which results in a loss of an effective heartbeat and death if not treated rapidly. These abnormal heart rhythms frequently occur spontaneously and without warning and may occur in any age group, although are more likely to occur in individuals who are over 50 years of age.

There are an estimated 250,000 - 360,000 SCAs in the United States each year; in Maryland there are approximately 4,000 SCAs each year. Most SCAs occur outside of a hospital; of those SCAs occurring outside of a hospital, approximately 80% are in residential settings and 20% in community settings.

The treatment for these abnormal heart rhythms is to shock the heart, a procedure called "defibrillation." Defibrillation is most effective if provided within 3 - 5 minutes of SCA and has limited or no effectiveness after 10 minutes. Cardiac arrests that occur secondary to other events, e.g., trauma, electrocution, drug overdose, or drowning may or may not require or benefit from defibrillation.

In the past, defibrillation was provided by healthcare providers (i.e., physicians, nurses and paramedics). With the development of computerized defibrillators called "automated external defibrillators" ("AEDs"), however, individuals with far less medical training (such as fire, police, and EMS first responders) may successfully defibrillate a victim of SCA. Fire and EMS personnel responding to 911 calls, however, are frequently not able to reach a victim of SCA within 10 minutes of the arrest. Poor outcomes from out-of-hospital SCA are generally related to the amount of time it takes these public safety personnel to reach the victim and administer defibrillation. Survival from a witnessed out of hospital SCA varies significantly from community to community, but is typically well below 10% (national published median 6.4%) with some notable exceptions such as Seattle, Washington.

Public Access Defibrillation

Since the early 1990's, there have been increasing calls for placing AEDs in the community for use by lay rescuers, a process collectively referred to as "Public Access Defibrillation" ("PAD"). PAD programs are based on the concept that AEDs are most effective when used within 3 to 5 minutes of SCA. Experience with PAD programs has also indicated that such programs are most effective when the AEDs are used by persons who have received appropriate training and when the AEDs are properly maintained. PAD programs have also been found to be effective at certain high volume facilities, such as international airports, where the device is mounted on the wall for access by bystanders who in many cases can successfully defibrillate the victim before staff arrives. This has led to recommendations that public access AEDs be stored in plain sight with signage for access by bystanders at high risk locations.

The effectiveness of defibrillation in a PAD program is directly related to two factors: 1) the percentage of arrests that are witnessed and 2) how often and how quickly the rescuers are able to obtain, correctly apply, and activate the AED. A "witnessed" cardiac arrest is one where a

bystander sees the victim collapse; the presence of such a bystander witness greatly increases the chances that the bystander will intervene to help the victim and/or summon others to provide immediate aid. Generally, an individual suffering an unwitnessed cardiac arrest has a poorer chance of survival. The rapid response of the rescuers is another important factor: every minute the victim is in cardiac arrest, chances of survival decrease by about 10%. The less time it takes the rescuer to obtain the AED from its location, take it to the victim's side, and apply the AED, the greater the changes of survival.

Studies have shown varying degrees of effectiveness of PAD programs. A recent study by the National Institutes of Health / National Heart Lung & Blood Institute indicated that PAD programs could potentially double the likelihood of successful resuscitation using trained lay rescuers with medical oversight at selected high risk locations[1]. Also, PAD programs at locations such as airports and casinos and with police officers have achieved remarkable results – 49% - 74% survival of victims of a witnessed SCA[2]. Studies of AEDs in homes (where most SCA occurs) have not been able to demonstrate effectiveness[3].

Despite its apparent effectiveness, however, concerns have been expressed about the cost-effectiveness of PAD programs. The cost-effectiveness of a given PAD program is related to a number of factors including the likelihood of a cardiac arrest occurring at the location and the likelihood that the victim will survive. Two factors generally increase the likelihood of a cardiac arrest occurring at a given location – exposure (expressed as the person-years of individuals at a particular location) and the characteristics of the individuals who are at the location (for instance, individuals who are over 50).

Cost-effectiveness in health care interventions is believed to occur when the intervention results in a cost equal to or less that $50,000 per year of life saved[4]. With SCA, studies and recommendations have indicated that this corresponds to one cardiac arrest per PAD location

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[1] Reed DB, Birnbaum A, Brown LH, O'Conner RE, et al. Location of Cardiac Arrests in the Public Access Defibrillation Trial. Prehospital Emergency Care. 2006; 10(1):61-67.

[2] Hazinski MF, Idris AH, Kerber RE, Epstein A, et al. Lay Rescuer Automated External Defibrillator ("Public Access Defibrillation") Programs: Lessons Learned from an International Multicenter Trial: Advisory Statement from the American Heart Association Emergency Cardiovascular Committee; the Council on Cardiopulmonary, Perioperative, and Critical Care; and the Council on Clinical Cardiology. Circulation. 2005; 111:3336-3340.

[3] 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, Part 5: Electrical Therapies: Automated External Defibrillators, Defibrillation, Cardioversion, and Pacing. Circulation. 2005; 112(suppl IV):IV-19-IV-34.

[4] Gold LS, Eisenberg M. Cost-effectiveness of automated external defibrillators in public places: Pro. Curr Opin Cardiolology 2007; 22(1):5-10.

every 5 - 10 years[5] [6]. Further, placement of AEDs at high risk locations is generally thought to be cost-effective because there is a greater likelihood that the AED will be used. However, these high-risk locations represent only a small percentage of all out-of-hospital SCAs: only 1 – 2 % if non-hospital health care facilities are excluded. Consequently, while cost-effective, placement of AEDs at high risk locations is likely to have little impact at a population level. PAD programs that place AEDs at low-risk locations are unlikely to be cost-effective since there is a smaller likelihood that the AED will ever be used. And AED placement at low-risk locations may be even less cost-effective than alternative approaches, such as prevention or improving public safety response to SCA.

Maryland Public Access Defibrillation

Maryland's PAD program was implemented in 1999[7]. The Program permits a business, organization, association, etc. ("authorized facility"), that meets certain requirements, to set up a program whereby someone suffering a cardiac arrest on the authorized facility's premises can receive treatment with an automated external defibrillator (AED) on-site by appropriately trained non-medical personnel before the arrival of emergency medical services personnel. An authorized facility may be a single organization located at one place or a business that operates at several locations (sites). In 2006, the Maryland General Assembly passed a law mandating AEDs at all public high schools in Maryland[8]. Participation by other types of facilities is currently voluntarily; however, if a facility determines to have an AED on site, it must participate in the Program.

Maryland's PAD Program sets forth specific requirements for authorized facilities, including training of AED operators by an approved AED training program. Authorized facilities meeting program requirements receive a certificate that is valid for three years if the facility remains compliant with the program requirements. The program requirements may be found at COMAR 30.06.01-05.

Since the inception of the Maryland PAD Program, there have been 38 successful AED uses out of 212 reported incidents (18%) at PAD sites. Success is defined as the victim having a return of pulse at EMS arrival or during EMS transport. Of the overall arrests, 125 were witnessed, and 34 of those witnessed arrests regained a pulse at the time of EMS arrival for a 27% save rate for witnessed cardiac arrests.

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[5] Cram P, Vijan S, Fendrick AM. Cost-effectiveness of Automated External Defibrillator Deployment in Selected Public Locations. J. General Internal Medicine. 2003; 18:745-754.

[6] 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, Part 5: Electrical Therapies: Automated External Defibrillators, Defibrillation, Cardioversion, and Pacing. Circulation. 2005; 112 (supp. IV):IV-19-IV-34.

[7] SB 294, Ch. 167, 1999; Ed. Art. §13-517, Ann. Code MD.

[8] HB 1200, Ch. 203, 2006; Ed. Art. §7-425, Ann. Code MD.

There are currently 874 facilities participating in the Program with just over 2,100 sites (see Appendix B). Of these, 53 sites are community pools (see attached listing and map showing community pool participants at Appendix C).

Public Policy Development

A number of resources may be utilized to guide the State in making public policy decisions regarding the response to out of hospital SCA. These include the following:

- National Guidelines, especially from the American Heart Association;
- Published peer-reviewed scientific studies;
- Legislative trends and initiatives in other states; and
- Available statewide data specific to cardiac arrests.

National Guidelines and Pertinent Peer-Reviewed Research

Current American Heart Association guidelines recommend PAD programs be established at locations that are likely to have at least one SCA every 5 years and where the public safety time to defibrillation is greater than 5 minutes. They also recommend that PAD programs be established at health clubs with > 2500 members and at places with a high likelihood of witnessed SCA such as international airports, casinos, and sports facilities.

Research generally supports the current AHA recommendations for PAD programs that have an emphasis on planning, training, practice of CPR and use of AEDs. Results support placement of AEDs in those public locations with a high incidence or likelihood of SCA (e.g., airports, golf clubs, health clubs, large industrial, sports, shopping malls).[9]

At least one published research study considers the AHA recommendation to be too conservative, however. This study indicates that PAD programs may be cost effective if there is a 12% annual likelihood of a sudden cardiac arrest at the location (at least once every 8-9 years)[10]. Further, in the National Institutes of Health / National Heart Lung & Blood Institute's Public Access Defibrillation Trial, high risk locations were defined as having a history of at least 1 cardiac arrest every 2 years or where there are 250 or more individuals 50 years or older for 16 hours or more a day. Results of the PAD trial indicate that the exposure-adjusted rate of SCA

[9] Hazinski MF, Idris AH, Kerber RE, Epstein A, et al. Lay Rescuer Automated External Defibrillator ("Public Access Defibrillation") Programs: Lessons Learned from an International Multicenter Trial: Advisory Statement from the American Heart Association Emergency Cardiovascular Committee; the Council on Cardiopulmonary, Perioperative, and Critical Care; and the Council on Clinical Cardiology. Circulation. 2005; 111:3336-3340.

[10] Cram P, Vijan S, Fendrick AM. Cost-effectiveness of Automated External Defibrillator Deployment in Selected Public Locations. J. General Internal Medicine. 2003; 18:745-754.

was highest in fitness centers and golf courses, even though the incidence per facility was low and average respectively[11] .

Legislative Trends

In 1997, states began enacting public access laws to encourage AED placement. All fifty states have now have enacted certain AED laws. A review of recent legislative activity indicates that a few states have passed legislation in the past several years requiring or supporting mandating the establishment of PAD programs in certain locations.

- Schools – SCA is less likely to occur in children as compared to adults (0.18 per 100,000 person-years for students versus 4.51 per 100,000 person years for faculty and staff). Despite this, the desire to ensure the safety and well-being of youth has led 10 states, including Maryland, to require PAD programs at some schools. NY requires PAD at school facilities with more that 1000 people on site.

- Health clubs, fitness centers, health spas, health studios, gyms, weight control studios, and martial arts schools with > 500 members. Seven states have enacted such laws with some exceptions to the requirements.

- Places of public assembly that typically host large numbers of people. Two states have enacted requirements for AEDs at these types of locations.

AED Location	States Requiring or Supporting AED Placement
Schools	**Colorado** (donations), **Florida, Illinois**, **Maryland, Michigan, Nevada, New York, Ohio, Pennsylvania and Virginia** require some schools to have portable defibrillators; actual extent varies.
Health Clubs	**California**, **Illinois**, **Massachusetts** (1/07), **Michigan**, **New Jersey**, **New York** and **Rhode Island** laws now require health clubs to have at least one AED. *Definition example (Michigan)*: "Health club" means an establishment that provides, as its primary purpose, services or facilities that are purported to assist patrons in physical exercise, in weight control, or in figure development, including, but not limited to, a fitness center, studio, salon, or club. A health club does not include a hotel or motel that provides physical fitness equipment or activities, an organization solely offering training or facilities for an individual sport, or a weight reduction center.
Places of Public Assembly	**New York** ('06); **Arizona** – any state building constructed or renovated at a cost of at least $250,000 must be equipped with AEDs.

From: The National Conference of State Legislatures: State Laws on Heart Attacks, Cardiac Arrest & Defibrillators – Encouraging or requiring community access and use. See: http://www.ncsl.org/programs/health/aed.htm

[11] Reed DB, Birnbaum A, Brown LH, O'Connor RE, et al. Location of Cardiac Arrests in the Public Access Defibrillation Trial. Prehospital Emergency Care. 2006; 10(1):61-67.

Maryland-Specific Data

MIEMSS initiated the Maryland Cardiac Arrest Surveillance System (MCASS) in 2001 to identify and characterize out-of-hospital sudden cardiac arrests in Maryland. Out-of-hospital sudden cardiac arrest is defined as any sudden stop in cardiac function that occurs out-of-hospital and in which the state EMS system is accessed for resuscitative services. Out-of-hospital SCAs occurring to individuals with valid EMS Do Not Resuscitate orders, those where the individual was identified as dead on the arrival of EMS at the scene as well as those that do not contact the EMS system (e.g., individuals under hospice care) are excluded from these surveillance numbers (see Study Limitations). Data from these studies from the period January 1, 2001 to December 31, 2006 were reviewed for this report to identify the location of the cardiac arrest (e.g., school, home, airport, etc.) and other factors.

There were 19,912 out-of-hospital cardiac arrests in Maryland between January 1, 2001 and December 31, 2006 that met the surveillance criteria and were reported to MIEMSS. Less than half of these cardiac arrests were witnessed events. The majority of the witnessed events were observed by a bystander. Cardiac arrests were highly likely to be witnessed when they occurred at BWI airport, on public transportation, restaurants and bars, churches, enclosed malls, courthouses, stadium, racecourses/racetracks, health clubs, dialysis centers, ambulances, and physician/dentist offices.

Table 1 shows lists the annual rates per facility per year of out of hospital witnessed SCA, with medical or unknown arrest etiology in Maryland by location type. The list further ranks locations among three incident rate category types based upon a relative ranking per facility per year: "high" (1 or more SCA every 10 years), "intermediate" (1 SCA every 11 - 100 years), or "low" risk (1 SCA every 101 years or more). In addition, the cumulative percents of total SCA are provided to gauge the influence that category ranking has on the overall SCA population. Rates will vary within location types based upon exposure: those locations that have greater numbers of individuals and demographic characteristics (e.g., bigger malls, amusement parks, and buildings as well as health clubs with larger memberships will have greater exposure and therefore a greater likelihood of SCA). The results of SCA by type of location are fairly consistent with other studies of SCA conducted in the U.S.; however, there have been relatively few such studies.

Results indicate the following locations as being at a "high" risk for a witnessed SCA (at least 1 witnessed SCA within a ten year period):

- BWI Marshall Airport (PAD program already in place)
- Skilled nursing facilities
- Dialysis centers
- Racecourses and racetracks
- Enclosed malls
- Hospitals and hospital premises

Results indicate the following locations as being at an “intermediate” risk for a witnessed SCA (at least 1 witnessed SCA every 11 to 100 years):

- Sports stadiums
- Rehabilitation facilities
- Ocean City beaches (PAD program already in place)
- Amusement parks
- Public parks
- Colleges and universities
- Golf courses
- Health clubs and related facilities
- Places of large public assembly
- Casinos should they be established in Maryland
- High rise residential facilities and housing complexes with greater than 250 individuals over the age of 50 present for 16 or more hours a day.

Results indicate the following locations as being at a “low” risk for a witnessed SCA (at least 1 witnessed SCA per > 100 years):

- Other airport (small)
- Adult day care
- Hotel / Motel
- Courthouse
- Ambulance (Commercial service transporting patient while en route)
- Industrial Place and Premises
- Restaurant / Bar
- Museum
- School / educational facility (PK – 12)
- Theater / Cinema
- Other Public Beach
- Physician / Dentist Office
- Church
- Home
- Youth Camp
- Community Pool
- Child Day Care
- Convention Center

The following locations are classified as “unknown,” indicating that there was insufficient information to complete a risk determination:

- Senior Living Housing
- Other Residential
- Bus / Bus Station
- Street / Highway
- Public Transportation

- Other Transportation
- Government Administration Building
- Public Building
- Retail Store (non-enclosed mall)
- Senior Recreational Center
- Other Building
- Recreational Center
- Urgent Care Facility
- Other Medical Facility

Cardiac Arrest at Community Pools – Special Considerations

As previously mentioned, the effectiveness of resuscitation from SCA is usually calculated based on the number of witnessed cardiac arrests of medical/cardiac or unknown etiology where an abnormal cardiac rhythm is suspected to be the primary cause. A number of other known conditions such as trauma and drownings may result in a cardiac arrest as a secondary condition. The likelihood of a cardiac arrest requiring defibrillation is very high in primary cardiac arrests because the primary problem is usually an abnormal heart beat that requires defibrillation. The likelihood of a secondary cardiac arrests needing defibrillation is very variable.

The ranking of the locations listed above, including pools, was calculated based on the number of witnessed cardiac arrests of medical/cardiac or unknown etiology where an abnormal cardiac rhythm is suspected to be the primary cause. Over the six-year study period, four (4) witnessed SCAs of medical/cardiac or unknown etiology and 13 drownings, for a total of 17 occurred at the 2,992 pools that were included in the study. One additional cardiac arrest was reported in someone with a terminal illness.

If all cardiac arrests at pools rather than just the medical/cardiac and unknown etiology were used, the resulting rate would be 1 SCA every 997.333 years. This rate is still very low relative to other locations. See Table 1.

Defibrillation at Pools – Safety Issues

Regarding the safety of applying an AED at a swimming pool, the American Heart Association advises that use of an AED at a pool presents a special situation and cautions that providing an AED shock to a victim lying in water or lying on a wet surface around a pool may cause burns or shocks to the victim or rescuers. When a drowning is suspected, the AHA recommends first removing the victim from the water, opening the airway, and attempting ventilations. If these actions fail to resuscitate the victim, an AED may be indicated and the following actions should be undertaken when an AED is available[12]:

1. Remove the victim from contact with water.
2. Drag the victim gently by the arms or legs, or use a blanket drag.

[12] American Heart Association. Heartsaver AED for the Lay Rescuer and First Responder. Page 3-5, 1997-99.

3. Dry the victim's chest quickly before attaching the AED.

Conclusions and Recommendations

The capability to provide defibrillation within 3 to 5 minutes of SCA should be in place through a PAD program, public safety, and/or the availability of AEDs or manual defibrillators for healthcare workers at the following high risk locations:

- BWI Marshall Airport (PAD program already in place)
- Skilled nursing facilities
- Dialysis centers
- Racecourses and racetracks
- Enclosed malls
- Hospitals and hospital premises

The capability to provide defibrillation within 3 to 5 minutes of SCA should be in place through a PAD program and / or public safety at the following intermediate risk locations based on national guidelines, legislative trends, and higher percentages of witnessed SCAs:

- Sports stadiums
- Rehabilitation facilities
- Ocean City beaches (PAD program already in place)
- Amusement parks
- Public parks
- Colleges and universities
- Golf courses
- Health clubs and related facilities
- Places of large public assembly
- Casinos should they be established in Maryland
- High rise residential facilities and housing complexes with greater than 250 individuals over the age of 50 present for 16 or more hours a day

Cost- effectiveness of PAD programs at intermediate risk locations is enhanced when the locations are large/high exposure facilities (e.g. health clubs with more than 500 members (AHA recommends 2500) or educational facilities with over 1000 students, faculty and staff present).

MIEMSS should continue to trend data from MCASS, review national recommendations, legislative trends, and published scientific studies and modify public policy as new information becomes available. Additionally, voluntary placement of AEDs at swimming pools and other community locations, as well as participation in PAD Programs should be encouraged; perceived barriers to participation in PAD Programs should be eliminated. The promising 27% "save rate" for witnessed SCA at facilities currently participating in the Maryland PAD Program serves as a public health incentive to encourage the growth of these programs; "save rate" means pulse at EMS arrival or while being transported. Also, serious consideration should be given to greater investment in public safety AED programs – fire, EMS, and police – that are capable of arriving and defibrillating within 5 minutes of arrest. At the present time, rapid response by public safety

the only potentially effective approach to addressing SCA in homes which account for the vast majority of SCAs.

Study Limitations

The MCASS database includes all out-of-hospital cardiac arrests in Maryland that are reported to MIEMSS. All EMS personnel that provide care to an individual in cardiac arrest are requested to submit copies of the following: (1) the Maryland Ambulance Information System (MAIS) Run Report or EMAIS equivalent; (2) the EMS Cardiac Arrest Supplemental Form; (3) a narrative explaining the history of the cardiac arrest and subsequent treatment; and (4) the AED or manual defibrillator summary report. The narrative is used to conduct quality assurance checks on responses provided on the other forms. The MAIS master database, which comprises ambulance run information from all EMS incidents regardless of the nature of the incident, is also queried for cardiac arrest cases that may have inadvertently not been submitted. These incidents are followed up to obtain the necessary study information. Response times are gathered from the MAIS report and validated from data provided by the local 9-1-1 systems. For some jurisdictions, data are submitted by E-MAIS, the electronic equivalent of the MAIS Run Report, EMS Cardiac Arrest Supplemental form and other reports.

All EMS jurisdictions in the state are expected to contribute information on all out-of-hospital sudden cardiac arrest cases seen by EMS. Rigorous un-duplication measures are taken to ensure that all documentation belonging to a single cardiac arrest incident is not split into multiple incidents. Currently, there is no way to completely un-duplicate incidents reported in the MAIS database. Therefore, information provided from this state EMS database may contain overestimates in the numbers. Also, the MCASS database does not contain all EMS jurisdictional information, including one of the largest jurisdictions in Maryland. The exact amount of underreporting is unknown, but estimated to be in the range of 20%. It is doubtful, however, that the underreporting will have a significant impact on the rank order of annual rates by location. Finally, variability of reporting may exist across jurisdictions; data have not been presented by jurisdiction in this report.

The statistics provided are generated from the Maryland EMS system. As such, they reflect only those out-of-hospital cardiac arrests that notified and utilized the EMS system. The data do not include out-of-hospital cardiac arrests that:

1. Do not contact the 9-1-1 system for care,
2. Contact the system but do not use the system due to the presence of a valid EMS Do Not Resuscitate Order, or
3. No resuscitative efforts were provided by EMS and the patient was classified as “Dead on Arrival” at the scene.

Also, this report provides a six-year aggregate of the data. Because cardiac arrests are a relatively rare event, small numbers may greatly impact percentages and rates. This data limitation is thought to directly affect the statistics associated with the locations in which cardiac arrests occur, since there are a large number of subcategories of locations within the five main categories.

Rates for the place of occurrence charts are calculated using denominators from various sources. Most of these sources are from state agencies or licensing bureaus and thought to be complete and accurate. Other denominators such as shopping malls were obtained from Internet lists and validated in statewide focus groups. Finally, other denominators such as the ones for churches, hotels/motels and restaurants/bars were obtained from the yellow pages phone book. The lists were checked for duplicates and misclassified listings; however, these denominators may provide an overestimate of the true rate since the definition demands that the place of occurrence have a listed phone number for the establishment. Averaging of the annual rates shown in the table may not accurately capture the impact of the size of a given location on the likelihood of an SCA event. Certain denominators, e.g., the number of streets and highways, could not be accurately determined.

Definition of Community Pools

Information regarding the number of swimming pools included in the study was obtained from the Department of Health & Mental Hygiene. Maryland State regulations define "Public Pools" to include three (3) classifications: 1) Recreational; 2) Semi-Public; and 3) Limited Public Use Pools. See the language of COMAR 10.17.01 which is shown in Appendix D. This report used all three types of public pools as the cardiac arrest denominator in determining the relative risk of a witnessed SCA at a community pool. This was done for several reasons. First, there was no definition of “pool” contained in the language of SB 742. Second, the DHMH information on public pools came from local health departments which did not necessarily report the type of “public pool.” Third, the Maryland cardiac arrest data collection did not differentiate among various types of community pools; rather, information was reported on “community pools” generally. Thus, the decision to use the combined number of all three types of public pools was determined to be reasonable.

If it is determined, however, that the combined pool number is inaccurate because it incorrectly includes pools that would not appropriately qualify as “community pools,” an alternative methodology is to calculate the number of such community pools it would take to make pools fall into the “high” risk category. Using this method, even if all 18 SCA victims (4 medical / cardiac / unknown etiology, 13 drownings and 1 terminally ill) were deemed to have all been in a shockable rhythm and thus eligible for use of an AED, the number of pools would have to decrease from the current number of 2,992 pools to no more than 30 in order for pools to be fall in the “high risk” category. And, in order for pools to fall into the “intermediate risk” category, the number of pools would have to be no more than 300. By any count, there are many more than 300 community pools within the State of Maryland. Thus, the risk of SCA at community pools cannot fall into the “high” or “intermediate” categories under any reasonable methodology.

Despite the limitations of the study, the MCASS data reported in this study are well within the range of data reported by other researchers.

Table 1. Ranked Out-of-Hospital Witnessed Cardiac Arrests with Medical or Unknown Etiology (All Ages), Calendar Years 2001-2006

	6 Yr. Total	Number Of Facilities	Rate of CA per Facility per Year	Years per CA per Facility	Percent of Total	Cumulative Percent
High Risk Locations						
Airport - BWI	13	1	2.1667	**0.462**	0.18	0.18
Skilled Nursing Facility	584	223	0.4365	**2.291**	8.29	8.47
Dialysis Center	122	77	0.2641	**3.787**	1.73	10.20
Racecourse/Racetrack	7	5	0.2333	**4.286**	0.10	10.30
Jail/Correctional Facility	34	43	0.1318	**7.588**	0.48	10.78
Retail Store (enclosed mall)	21	32	0.1094	**9.143**	0.30	11.08
Hospital Place and Premise	45	75	0.1000	**10.000**	0.64	11.72
Intermediate Risk Locations						
Stadium	9	19	0.0789	**12.667**	0.13	11.85
Rehabilitation Center	45	97	0.0773	**12.933**	0.64	12.49
Public Beach - Ocean City	2	6	0.0556	**18.000**	0.03	12.51
Amusement Park	2	8	0.0417	**24.000**	0.03	12.54
Park	31	163	0.0317	**31.548**	0.44	12.98
School/Educational Facility (College)	11	66	0.0278	**36.000**	0.16	13.14
Train/Train Station	14	116	0.0201	**49.714**	0.20	13.34
Ambulance-Jurisdictional (in route)	73	611	0.0199	**50.219**	1.04	14.37
Assisted Living Facility	148	1,363	0.0181	**55.257**	2.10	16.47
Golf Course	21	202	0.0173	**57.714**	0.30	16.77
Health Club	20	267	0.0125	**80.100**	0.28	17.05
Low Risk Locations						
Airport - Other	2	35	0.0095	**105.000**	0.03	17.08
Adult Day Care	9	162	0.0093	**108.000**	0.13	17.21
Hotel/Motel	51	1,532	0.0055	**180.235**	0.72	17.93
Courthouse	1	34	0.0049	**204.000**	0.01	17.95
Ambulance-Commercial (in route)	7	261	0.0045	**223.714**	0.10	18.05
Industrial Place and Premise	65	3,910	0.0028	**360.923**	0.92	18.97
Restaurant/Bar	115	7,253	0.0026	**378.417**	1.63	20.60
Museum	1	69	0.0024	**414.000**	0.01	20.62
School/Educational Facility (PK-12)	32	2,604	0.0020	**488.250**	0.45	21.07
Theatre/Cinema	2	163	0.0020	**489.000**	0.03	21.10
Public Beach - Other	2	191	0.0017	**573.000**	0.03	21.13
Physician/Dentist Office	76	8,553	0.0015	**675.237**	1.08	22.20
Church	46	5,506	0.0014	**718.174**	0.65	22.86
Home	4503	1,980,859	0.0004	**2639.386**	63.89	86.75
Youth Camp	1	522	0.0003	**3132.000**	0.01	86.76
Community Pool	4	2,992	0.0002	**4488.000**	0.06	86.82
Child Day Care	1	13,690	0.0000	**82140.000**	0.01	86.83
Convention Center	0	3	0.0000	**0.000**	0.00	86.83
Unranked Locations						
Senior Living Housing	60	Unk			0.85	
Other Residential	71	Unk			1.01	
Bus/Bus Station	3	Unk			0.04	
Street/Highway	363	NA			5.15	
Public Transportation	8	NA			0.11	
Other Transportation	26	NA			0.37	
Government Admin. Building	35	Unk			0.50	
Public Building	69	Unk			0.98	
Retail Store (non enclosed mall)	93	Unk			1.32	
Senior Recreation Center	3	Unk			0.04	
Other Building	36	Unk			0.51	
Recreation Center	14	Unk			0.20	
Other Recreation Place	61	Unk			0.87	
Urgent Care Facility	4	Unk			0.06	
Other Medical Facility	19	Unk			0.27	
Unknown	63	Unk			0.89	
Total	7048	NA			100.00	

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Appendix A: AED Task Force & Meeting Attendees

AED Task Force

1. American Heart Association
Michaeline Fedder, M.A.
Director of Advocacy
P.O. Box 17025
Baltimore, MD 21203

2. Board of Physician Quality Assurance
Ira N. Brecher, M.D.
4201 Patterson Avenue
Baltimore, MD 21215

3. Safety Council of Maryland
Ms. Pat Raven
17 Governors Court
Baltimore, MD 21244

4. Maryland State Firemen's Association
Lee Sachs
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Towson, MD 21285-6724

Charles Wills
32 Elder Place
Indianhead, MD 20640

5. MD Dept. Health and Mental Hygiene
Roger L. Harrell, M.D.
Dorchester County Health Department
751 Woods Road
Cambridge, MD 21613

6. Baltimore Fire Officers Association
Capt. Dickson Henry
Quality Improvement Officer
Baltimore City Fire Department – EMS Division
6720 Pulaski Highway
Baltimore, MD 21237

7. Maryland State and DC Professional Fire Fighters
Kathleen Grote
8501 Veterans Highway
Millersville, MD. 21108

8. American Red Cross
James H. Friedline
Health Services, American Red Cross
4700 Mt. Hope Drive
Baltimore, MD 21215

AED Task Force Meetings
Members and Guests

June 11, 2007
Charlie Wills, Maryland State Firemen's Association
Lee Sachs, Maryland State Firemen's Association
Jon Fiedler, Montgomery County Fire & Rescue
Michaeline Fedder, American Heart Association
Diane Cooke, Chesapeake Regional Safety Council
Pam Engel, DHMH
Manning Feinleib, Johns Hopkins University School of Public Health
James H. Friedline, American Red Cross
Kathleen Grote, Maryland & District of Columbia Professional Fire Fighters
Roland Berg, Prince George's County Fire & EMS
Sandy Martin, Cardiac Arrest Survivor
Roger Harrell, Dorchester County Health Dept. / DHMH
Milton Zepp, Carroll County

August 20, 2007
James H. Friedline, American Red Cross
Milton Zepp, Carroll County
Mary Becker
Bill Becker, III
Kathleen Grote, Maryland & District of Columbia Professional Fire Fighters
Jon Fiedler, Montgomery County Fire & Rescue
Eric Backus
Stephanie Horney
Suzane Bussey
Lee Sachs, Maryland State Firemen's Association
Diane Cooke, Chesapeake Regional Safety Council
Sandy Martin, Cardiac Arrest Survivor
Ira Brecher, Montgomery County
Roger Harrell, Dorchester County Health Dept. / DHMH
Roland Berg, Prince George's County Fire & EMS
Linda Rudy, DHMH

November 9, 2001
Michael Millen, M.D., Johns Hopkins
Stephanie Horney
Suzane Bussey
Jon Fiedler, Montgomery County Fire & Rescue
Roger Harrell, Dorchester County Health Dept. / DHMH
Roland Berg, Prince George's County Fire & EMS
Lee Sachs, Maryland State Firemen's Association
James H. Friedline, American Red Cross
Pam Engle, DHMH
Michaeline Fedder, American Heart Association
Betsy Vedder, American Heart Association

Appendix B: Maryland AED Facility Program (PAD Program) Participants

Statewide_AED_Report Revised.pdf

Appendix C: Pools Participating in Maryland AED Facility Program (PAD Program) and Map

AEDs at Community Pools.pdf

AED_Community_Pools_11_07_07_Zoom.

Appendix D: COMAR 10.17.01.05 Definitions

I. Public Pool and Public Spa

(18)(a) "Public pool" and "public spa" mean a pool or spa that is not a private pool or spa.

(b) "Public pool" includes a:

(i) Limited public-use pool, as defined in §B(7) of this regulation;
(ii) Recreational pool as defined in §B(19) of this regulation; and
(iii) Semipublic pool, as defined in §B(22) of this regulation.

(7) Limited Public-Use Pool.

(a) "Limited public-use pool" means a private pool which is made available for use by:

(i) Children in family day care under the care of a family day care provider at a family day care home as defined in COMAR 07.04.01; or
(ii) An organized group, agency, or other person for swimming lessons or water safety training.

(b) "Limited public-use pool" does not include a pool that is emptied of water, disinfected, and refilled with water between each use.

II. Recreational Pool

(19) "Recreational pool" means a pool that:

(a) Is not a limited public-use pool, private pool, or semipublic pool, as defined in §§B(7), (17), and (22) of this regulation;

(b) Is provided as the owner's primary business or the facility's primary purpose, for example, a swim club or similar facility;

(c) Is open for general admission to the public;

(d) Is available to an individual paying a fee for use of the pool;

(e) Is equipped with a sliding board, diving platform, water slide, water flume, or water recreational play equipment that is built into or attached to the pool structure;

(f) Is provided by, or used by a:

(i) Youth camp;
(ii) College, university, or school;

(iii) Municipality;
(iv) Water park, amusement park, or water recreational attraction as defined in §B(34) of this regulation; or
(v) An apartment complex, housing subdivision, or mobile home park with more than ten units, except as provided in §B(22)(a)(v) of this regulation; or

(g) Is used more than 4 times a week for swimming lessons, water safety instruction, or swimming competition.

III. Semipublic pool / spa
(22) "Semipublic pool" and "semipublic spa" mean a pool or spa at a facility that:

(a) Has pool use or spa use restricted to an individual:

(i) Staying at the facility, where the facility is a temporary dwelling, including a hotel, motel, campground, bed and breakfast having nine or more guest rooms, or similar temporary dwelling;
(ii) Holding membership at the facility, where the facility is an adult health club, retirement community, marina, condominium, or similar facility;
(iii) Residing at an apartment complex, housing subdivision, or mobile home park with ten units or less;
(iv) Receiving treatment at a physical therapy center pool, or spa, where the pool or spa is used for providing therapy; or
(v) Who is the owner or an owner of the pool or spa; and

(b) Has a pool or spa that is not:

(i) Open for admission to the general public, except as provided in §B(22)(a) of this regulation;
(ii) Available to an individual upon the payment of a fee for the use of the pool and spa;
(iii) A limited public-use pool, a private pool, a private spa, or
(iv) Equipped with a sliding board, diving platform, water slide, water flume, or water recreational play equipment that is built into or attached to the pool structure; and
(v) At a bed and breakfast that has eight or fewer guest rooms.