Cardiac Survivability in Evendale, OH, an Analysis of Automated External Defibrillator Programs in Industrial and Commercial Facilities

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CERTIFICATION STATEMENT

I hereby certify that the following statements are true:

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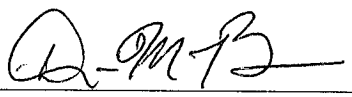
Signed: 

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ABSTRACT

Preservation of life is the primary mission of Evendale Fire Department (EFD). Evendale has many large or densely populated occupancies. These types of occupancies are American Heart Association (AHA) targets for public access defibrillation (PAD). Most instances of sudden cardiac arrest (SCA) in Evendale occur in industrial and commercial occupancies. EFD is aware that automated external defibrillators (AEDs) exist in the community, however, does not know the locations or track them. The problem this descriptive research project studied is cardiac survivability in commercial and industrial premises in Evendale, OH.

The research questions this study investigated are:

1. Which industrial and commercial businesses currently have an AED program?
2. What type of AED programs exist?
3. What are the benefits of having an AED program?
4. How can businesses benefit from AED program implementation?

Time is the enemy in SCA. There are several ways to decrease the time to defibrillation, including AED placement and the use of nontraditional responders. Studies show that SCA is more likely with areas where people are concentrated, are at high risk for SCA, or SCA has occurred relatively recently. Trials using nontraditional responders and AED grids have resulted in decreased time to defibrillation. Time saved has translated into improved survival to hospital discharge.

21 AEDs were discovered using the survey. The AED types and programs varied. The survey also showed a need for AED education. Compatibility with EFD's equipment could pose a problem. Additional information and planning were advised. Many strategies, including

education of businesses, support of existing AED programs, performance of additional surveys and utilization of the police as first responders were recommended.

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INTRODUCTION

Statement of the Problem

"We are dedicated to preserving life and property and promoting public safety to our residents and visitors by focusing our efforts on responding rapidly to emergencies, providing appropriate intervention, and community education." (Evendale Fire Department Mission Statement).

"Safety: The preservation of life remains the number one goal of the Evendale Fire Department, beginning with the responder and extending to the public." (The first of six "core values" of the Evendale Fire Department).

Preservation of life is the main purpose of the EFD. Cardiac event survivability is both a mission and a core value of EFD. Evendale's large commercial and industrial populations are great candidates for PAD and AED programs to preserve lives in these populations. Large structures can cause delays in finding the victim of cardiac arrest. Concentrations of people lower the cost per life saved with AEDs. Strategic placement of these devices could make a positive impact on the time it takes to resuscitate. The time saved would have a positive impact on the long term survivability and quality of life of the arrest victims. EFD could assist in the development and maintenance of these programs as an additional service to the businesses. Knowledge of existing programs is the first step in analyzing the needs of the business community, and examining the need for expansion and support of these programs, or may justify the implementation of new programs.

The goal of this research was to improve the response time to victims of sudden cardiac arrest (SCA) in the large structures and areas of high population density in Evendale. Improved response times should lead to improved outcomes to the victims of SCA.

The problem this study will address is cardiac survivability in commercial and industrial premises in Evendale, OH. Currently, there is no measurement of AED programs in the community. The research method chosen for this study was descriptive.

Purpose of the Study

The purpose of this study was to discover AED programs that currently exist in the community and examine the need or benefits of integrated programs.

Research Questions

The research questions this study investigated are:

1. *Which industrial and commercial businesses currently have an AED program?*
2. *What type of AED programs exist?*
3. *What are the benefits of having an AED program?*
4. *How can businesses benefit from AED program implementation?*

BACKGROUND AND SIGNIFICANCE

The Village of Evendale is about 5 square miles and has a small residential population of 2,767 (US Census Bureau, 2010 census) with a large commercial and industrial population. There are over 200 businesses, and many employ >50 people, with the largest employing approximately 4,500 people. Many of these businesses meet the AHA criteria for AED placement.

EFD consists of 23 full-time firefighter paramedics, 2 full-time firefighter EMTs and 1 administrative assistant. All personnel, with the exceptions of the chief and administrative assistant, remain on station for their 24 hour shift. All personnel, minus the administrative assistant, are trained in CPR and AED use. EFD runs 2 advanced life support (ALS) ambulances

and has an ALS equipped engine. All staff vehicles are equipped with basic life support (BLS) equipment with an AED in the equipment complement.

EFD has a Cardio-Pulmonary Resuscitation (CPR) program, which includes instruction in AED use. EFD does not track AED programs currently operating in Evendale. EFD is aware of a handful of facilities with AEDs, including schools and fitness centers; however, the tracking is anecdotal. EFD provides support by way of training, with no coordinated outreach to these facilities.

Evendale is an anomaly in regards to sudden cardiac arrest (SCA). Over the last ten years, 60% of cardiac arrests have occurred in industrial or commercial occupancies. The national average for these occupancies is 13.2% (McNally et al., 2011). Cardiac event survivability may best be impacted through promotion of integrated PAD programs.

The potential impact this study could have on the Evendale Fire Department is improved cardiac arrest outcome with increased use of AEDs in commercial and industrial facilities. Lay persons trained in CPR and AED use could double the survivability of sudden cardiac events in the community. Implementation of AED programs could help EFD realize future goals through accomplishment of mission, improved public relations, increased job satisfaction and increased survivability for people living and working in Evendale.

LITERATURE REVIEW

According to McNally, et al. (2011), 300,000 people experienced out of hospital cardiac arrest (OHCA) in the United States annually. About 92% of these people did not survive. McNally, ET al. were able to garner data from three existing information registries to shed light on the current state of response and outcomes for out of hospital cardiac arrest (OHCA). These registries represented a population of twenty two million people, and represented the first national data set for OHCA.

McNally et al. (2011), working under the Cardiac Arrest Registry to Enhance Survival (CARES) combined and verified the data sets obtained from the Utstein template, the National EMS Information System (NEMSIS) and the Resuscitation Outcomes Consortium (ROC).

CARES analyzed 31,689 OHCA events of viable cardiac patients occurring between October 1, 2005 and December 31, 2010. Cares found that the average victim was male (61%) and 64 years old. Of these events, 21.6% were pronounced dead at the scene. 26.3% survived to hospital admission. 9.6% survived to hospital discharge. 36.7% were bystander witnessed. 33% received bystander CPR. 3.7% received AED defibrillation before EMS arrived.

CARES found that 30.1% survived to hospital discharge if the event was witnessed and the person was in a shockable rhythm. If the bystander performed CPR, AED defibrillation, or both, the survival rate increased to 33.7%.

CARES also discovered that 23.5% survived to hospital discharge if a bystander applied an AED. This compares to 9.1% survival to discharge when the 911 responder is first to apply the AED. CARES states a 26.3% survival to hospital discharge when there is a return of spontaneous circulation.

CARES also examined the locations where OHCA occurs. 11.3% of OHCAs happen in the residence or nursing home. 5.9% of OHCAs occurred in a public building. 1.3% were in a recreational or sports facility. 0.7% were in an industrial place. These findings can be used to focus PAD and CPR efforts to improve survival.

Neumar et al., (2011) discussed the recommendations of the 2009 AHA Cardiac Arrest Survival Summit. Improved data collection systems on local and national levels are recommended to improve program quality and allow for timely review of cases. The consensus cited the system constructed by Seattle and King County. Improved response, due to the organizational system had a larger effect than patient factors. The group set benchmarks and quality improvement goals, including tracking the median percentage of bystander AED use in a witnessed arrest in public, and improving the rate over 3 year intervals. Strategies recommended by the group included AED mapping with cell phone access and AED placement in all public buildings which had a SCA event within the previous year. AED mapping would allow

optimization of AED deployment in locations where SCA is most common. The group cited the absence of a national system for data analysis of SCA events as a major impediment for future quality improvement of PAD programs. Also cited is the need to change the culture of bystander participation. The lay public need to embrace the chain of survival, failure to perform CPR would become unacceptable.

Weisfeldt (2007) compared the effectiveness of different rescue combinations in his study of 9897 people with OHCA. Bystander CPR without AED resulted in 8% survival. This rate jumps to 33% for Bystander CPR when the bystander applied the AED and administered shocks. He concluded that the impact of PAD programs is significant on cardiac arrest survival to hospital discharge, but limited due to sparse availability of AEDs in the community.

In their review of the King County study, Culley et al. (2004) noted that PAD AED treatment resulted in 50% survival, which was significantly better than most EMS systems. The system used was in concert with an EMS Community Responder AED program to ensure proper response for cardiac arrest.

PAD programs have a dramatic positive effect on cardiac survivability. Kitamura et al. (2010), in a study involving 312,319 adults in Japan, saw survivability from ventricular fibrillation more than double when the victim received AED shocks. Kitamura also found that widespread distribution of AEDs reduced the time elapsed from event to shock. Mean shock time decreased from 3.7 minutes to 2.2 minutes. Increased 1 month survival rates with minimal neurologic damage were achieved.

Hallstrom (2004), in the Public Access Defibrillation trial, showed that victims rescued by lay rescuers trained in the use of AEDs had twice the survival rate than rescuers trained in CPR alone, when comparing OHCA. Survival to hospital discharge improved from 15% to 30%.

Handley et al. (2005), while analyzing the chain of survival, cited defibrillation studies showing survival rates up to 75% with defibrillation within 3-5 minutes of collapse. Survival to discharge drops up to 15% with each minute of delay to defibrillation. Timely defibrillation resulted in markedly better outcomes.

The frequency of SCA in public places varies. The risk of cardiac events must be taken into consideration. Some occupancy types have higher incidences than others. The frequencies of events have been compared in several studies to help determine the best allocation of resources.

Atkins (2009) discussed locations which have a higher potential for SCA, warranting a PAD program. Recommended locations included airports, prisons, shopping malls, sports facilities including gyms and golf courses. Additionally, PAD should be targeted in places that have high risk people, or have EMS response greater than 5 minutes and a history of SCA within the past 5 years. Schools are mentioned, not for risk, but for the excellent bystander response found, including a study finding 83% of SCAs receiving defibrillation.

Locations with high potential for SCA are explored in a Seattle study referenced by Becker, Eisenberg, Fahrenbruch and Cobb (1998). Cited are 10 locations which had a relatively high risk of SCA. Included are airports, jails, shopping malls, sports facilities and senior centers. These locations had an arrest rate of greater than or equal to 1 arrest per 30 sites. They recommended placement of AEDs prioritizing chance of arrest by site type.

Folke et al. (2009) compared the recommendations of the European Resuscitation Council, which recommends AED placement at locations with SCA within 2 years, and found them to be less desirable than the recommendations of the AHA. AHA guidelines suggesting placing AEDs in locations with SCA incidence within 5 years. They used a study of Copenhagen's PAD placement and tracking of SCA. Findings target transportation, shopping,

high density areas and sports centers for optimal AED placement. Strategic placement helps to keep costs in line.

Pell et al. (2002) promotes locations with non-traditional first responders, such as police and security guards, to implement PAD programs with marked reduced response times. The reduction of time to defibrillation dramatically improves survival. In a Scottish Ambulance Service Cohort study, defibrillation time was reduced to less than or equal to 3 minutes for 70.1% of patients.

Several types of AED programs exist. The type of program has a profound effect on survival and cost-effectiveness. Programs vary by occupancy type, history of arrest, placement by geography, and integration of systems.

Public PAD was compared, by Folke et al. (2010), to residential PAD in the Copenhagen study of 1994 to 2005. Likelihood of a shockable rhythm was lower for residential events compared to public events. Establishing a local AED registry was recommended. This would allow emergency dispatchers to forward AED locations to rescuers. .

Hazinski et al. (2005) examined the AHA PAD Trial in their advisory statement. They note that PAD works best within a system that monitors the maintenance, and allows analysis of data for quality improvement. They emphasized planning, training, and practice with AEDs for improved outcomes. Additionally, AED placement in PAD facilities should be located within a 1 to 1.5 minute brisk walk from any location.

Businesses have to weigh the benefits versus costs of program implementation. In some occupancies, risk and history do not justify the expense. Advances and simplification of AEDs have led to a greater clinical and cost effectiveness. Use of AEDs by bystanders appears to be

safe and effective. Future increased access and use are supported by literature, and should improve sudden cardiac arrest survival (Marenco, Wang, Link, Homoud and Estes 2001).

Rea and Page (2010) advise balancing benefits against cost in terms of money, people and training. Targeted, non-traditional public responders are discussed by Nichol et al. (2003) in a PAD equipped casino study. Cost effectiveness of AEDs by responder type was evaluated. They concluded that use of nontraditional responders can help keep program costs down. They also recommended considering frequency of arrest for PAD placement.

Winkle (2010) recognized the improvement of survival rates gained through AEDs, but questioned the cost. He broke down the cost against quality years of life. He used location types to further delineate cost differences. AED associated costs for airplane use was about $35,000 per quality year of life. Shopping malls and sports venues cost between $500,000 and $2,000,000 per quality year of life. Analysis of large industrial sites, community centers and health clubs ranged from $1,000,000 to $10,000,000 per quality year of life saved. Winkle stated that costs on the low end of the spectrum are within medically accepted procedures. Costs in the millions of dollars per quality years of life saved are not in line with the generally accepted healthcare expenditures. Winkle did acknowledge, however, that there may be an advantage to placement of AEDs in high visibility public locations to improve public awareness of SCA.

In contrast, Neumann, Jacobson, and Palmer (2008) warned against cost analysis when considering human capital. They espoused that cost benefit and cost effectiveness analyses are beyond the capability of local agencies. Value measurement cannot be done without core data sets. They also cited a lack of agreement on input and output measures. Their high priority is to establish a consensus on data to collect to be able to analyze costs versus benefits in public health.

PROCEDURES

This descriptive research project began with utilization of Google Scholar with a directed search concentrating on PAD research and programs. Additional references were obtained through referenced citing on articles and studies initially obtained. An education specialist of trauma services also assisted accessing pertinent resources at the University of Cincinnati Research Library.

Department SCA data was obtained through search of emergency medical service (EMS) incident reports logged in the Firehouse program. Searches keyed in on staff procedures involving CPR or defibrillation.

An original survey was conducted via phone with business owners or managers to obtain information sought for the research questions. The survey targeted industrial and commercial businesses in Evendale that met the AHA recommended criteria for PAD program location (AHA ECC guidelines 2000).

These criteria are:

-There is a reasonable probability of AED use.

-The EMS call to shock time may be greater than 5 minutes.

-An EMS call to shock time of less than 5 minutes can be achieved if lay persons function as first responders, recognizing cardiac arrest, calling 911, initiating CPR and operating an AED.

Information to be collected included the number of employees on site, the typical occupancy number, a percentage estimate of employees and clientele over 50, the presence of AEDs in the workplace, and if so, the type of program used.

After developing the survey, it was tested on a group of peers familiar with AEDs. It was

also tested by a business owner in Evendale, the target audience for the survey. Feedback and recommendations were taken into consideration, and the questions were adjusted accordingly.

82 surveys were attempted through appropriate business owners or managers. This number was obtained by querying firehouse records for cardiac arrest history in the last 5 years, and personal knowledge of the businesses in the community that meet at least 1 of the aforementioned criteria. 49 surveys were completed. 33 surveys were not obtainable due to business closings, disinterest in survey participation or inability to ascertain a suitable respondent. Of the 49 completed, 4 were not able to answer all appropriate questions.

Definition of Terms

Automated External Defibrillator. "A device that automatically analyzes the heart rhythm and that, if it detects a problem that may respond to an electrical shock, delivers a shock to restore a normal heart rhythm" (MedicineNet.com) Retrieved from http://medterms.com/

Limitations of the Study

Limitations of this study included the participant's willingness to complete the study, the personal knowledge of the individual about his/her workplace, and possible improper business selection for the survey.

Only 82 of the businesses in Evendale were selected to complete the survey. Of those 82 selected, only 49 respondents agreed to complete the survey. The accuracy of the information collected relied upon the respondent's knowledge of the demographics of the business.

RESULTS

1. Which industrial and commercial businesses currently have an AED program?

   Through survey, 21 existing AED programs were discovered in Evendale. The programs were discovered in a variety of occupancies. Occupancies were: 2 service, 5 educational, 5 commercial, 1 office, 6 manufacturing, 2 medical, 1 sports/rec.

2. What type of AED programs exist?

   There were seven different AED manufacturers discovered- Medtronic, Zoll, Heartstream, Physio, Mastertrack, Defib Tech, and Powerheart. The programs ranged from affixed to the wall in employee spaces to public spaces. AEDs were both stationary and mobile, with first responders, trained employees, untrained employees and the public available to administer the defibrillation

3. What are the benefits of having an AED program?

   Literature review suggests that the best way to improve survival to hospital discharge is by decreasing the time to shock. This can be accomplished through increased availability of AEDs, improved response time by nontraditional responders and improved response by traditional responders. Of respondents surveyed, 21 of 49 stated that they knew a lot about AEDs. The cost of the device was known to18 of 49 respondents.

4. How can businesses benefit from AED program implementation?

   In high risk locations, businesses can protect the lives of employees or clients with AED availability. The survey revealed many occupancies that fit the AHA recommendation for a PAD program. During open times, 17 of 49 respondents have more than 50 people in the business during. In 3 of 49 respondents had more than 51 percent of employees 50

years old, or over. High visibility AEDs can help promote public knowledge of SCA and improve bystander response to events to improve survival.

DISCUSSION

The literature review clearly showed the benefits derived from PAD programs. The best way to achieve a positive outcome from SCA is to defibrillate quickly. The time elapsed after 2 minutes results in a 10-15% decrease in survivability to hospital discharge with each additional elapsed minute. While industry standards recommend response time of less than five minutes, our goal should be to achieve defibrillation as quickly as possible, with the best possible outcome occurring at two minutes or less. This benchmark is hard to achieve for a responder coming from a centrally located firehouse responding to large facilities. Decreased response times can be achieved through use of nontraditional responders closer to the scene of the SCA. This may best be accomplished through planning and AED availability.

There are a variety of AED programs in and available to the community. With different manufacturers of AEDs, the ease of use varies. The devices may or may not be compatible with EFDs equipment. This may be another possible cause of delay, if not planned for. Different AED programs are appropriate for different facilities. The mobile units are a good fit for the businesses with large campuses and employees spread out. High density areas may be more appropriately served with a highly conspicuous stationary AED that is easy to use. The business must decide if the expenditure is worth the benefit. Research is split on the cost effectiveness of widespread AED use.

For EFD, promotion and support of AED use aligns with our mission and core values. Support of PAD programs could allow us to realize more lives saved. The process of obtaining the information through survey gave an opportunity to promote life safety, discuss SCA, and

offer support to the businesses through training and planning for SCA events. While discussing these events, we also received requests for building tours, CPR training, and tornado and fire extinguisher drills. The survey process was a good public relations opportunity that we were able exploit for the good of the community.

RECOMMENDATIONS

Based on the research and survey results, EFD should consider the following actions to improve cardiac survivability in the commercial and industrial facilities of Evendale. These recommendations are intended to make best use of the existing AED programs through planning, training, and practice sessions, and to improve response time to SCA for better outcomes of these events.

1. AEDs should be placed in all of the Evendale police cruisers to cut response time. Patrol cars in the area of the SCA may be better positioned for fast defibrillation of the patient. EFD can provide support by implementing a training program and quality improvement program.
2. EFD can provide support for existing AED programs. We can provide direction, if needed, for placement planning of AEDs and guidance on which type of program to use. We can support the business through training employees, and provide practice sessions to keep employee skills sharp.
3. EFD should reach out to businesses that fit the criteria for having a PAD program, and educate the business on the benefits that can be provided by implementing a PAD program.
4. EFD should start tracking the time to patient on routine calls, and see if the squad arrives in a timely manner. Time to defibrillation should also be tracked. Currently, arrival time

is tracked, but tracking the time to reach the patient would help discover facilities in which delays are caused by size of the facility, layout of campus, or poor communication of patient location exists. EFD could educate the employees of these facilities on how to assist the paramedics in getting to the patient quickly. This may be accomplished by establishing emergency response teams at the facility.

5. All AEDs found by survey should be recorded by location and attached to the building's premise report with 911 dispatch. This would allow the dispatcher to inform 911 callers of AED availability at the facility to speed defibrillation.
6. EFD should implement an AED tracking and review process. Tracking of AED use and patient outcome can be used to evaluate program effectiveness.
7. To discover all AEDs in the jurisdiction, the AED survey should be expanded to include all businesses in Evendale. A goal of 100% survey completion should be attempted. Conducting the survey also provides a good opportunity to educate the business about the benefits of AEDs, employees trained in CPR, and the support services EFD can provide.

REFERENCES

American Heart Association, (2000). Part 4: the automated external defibrillator : key link in the chain of survival. *Circulation, 102*, I-60-I-76. doi: 10.1161/01.CIR.102.suppl_1.I-60

Atkins, D.L., (2009). Public access defibrillation : where does it work? *Circulation, 120*, 461-463. doi:10.1161/CIRCULATIONAHA.109.883488

Becker, L., Eisenberg, M., Fahrenbruch, C., & Cobb, L., (1998). Public locations of cardiac arrest : implications for public access defibrillation. *Circulation, 97,* 2106-2109. Retrieved from http://circ.ahajournals.org

Culley, L.L., Rea, T.D., Murray, J.A, Welles, B., Fahrenbruch, C.E., Olsufka, M., Eisenberg, M.S., & Copass, M.K. (2004). Public access defibrillation in out-of-hospital cardiac arrest : a community-based study. *Circulation, 109,* 1859-1863. doi:10.1161/01.CIR.0000124721.83385.B2

Evendale Fire Department, (2011). *Mission statement.*

Evendale Fire Department, (2011). *Core Values*

Folke, F., Lippert, F.K., Nielsen, S.L., Gislason, G.H., Hansen, M.L., Schramm, T.K., Sorenson, R., Fosbol, E.L., Andersen, S.S., Rasmussen, S., Kober, L., & Torp-Pedersen, C. (2009). *Circulation, 120,* 513-517. doi:10.1161CIRCULATIONAHA.108.843755

Folke, F., Gislason, G.H., Lippert, F.K., Nielsen, S.L., Weeke, P., Hansen, M.L., Fosbol, E.L., Andersen, S.S., Rasmussen, S., Schramm, T.K., Kober, L., & Torp-Petersen, C., (2010). Differences between out-of-hospital cardiac arrest in residential and public locations and implications for public-access defibrillation. *Circulation, 122,* 623-630. doi: 10.1161.CIRCULATIONAHA.109.924423

Hallstrom, A., (2004) Public-access defibrillation and survival after out-of-hospital cardiac arrest. *N Engl J Med, 351,* 637-646. Retrieved from nejm.org

Handley, A.J., Koster, R., Monsiuers, K., Perkins, G.D., Davies, S., & Bossaert, L. (2005). European resuscitation council guidelines for resuscitation 2005 section 2. Adult basic life support and use of automated external defibrillators. *Resuscitation, 67S1,* S7-S23. doi: 10.1016/j.resuscitation.2005.10.007

Hazinski, M.F., Idris, A.H., Kerber, R.E., Epstein, A., Atkins, D., Tang, W., & Lurie, K., (2005). 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,111,*3336-3340. doi: 10.1161/CIRCULATIONAHA.105.165674

Kitamura, T., Iwami, T., Kawamura, T., Nagao, K., Tanaka, H., & Hiriade, A., (2010). Nationwide public access defibrillation in Japan. *N Engl J Med, 362,* 994-1004. Retrieved from nejm.org

Marenco, J.P., Wang, P.J., Link, M.S., Homoud, M.K., & Estes, N.A. 3rd, (2001) Improving survival from sudden cardiac arrest: the role of the automated external defibrillator. *JAMA, 285*(9), 1193-1200. Retrieved from jama.ama-assn.org

McNally, B., Robb, R., Mehta, M., Vellano, K., Valderrama, A.L., Yoon, P.W., Sasson, C., Crouch, A., Perez, A.B., Merritt, R., & Kellermann, A., (2011). Out-of-hospital cardiac arrest surveillance-Cardiac Arrest Registry to Enhance Survival (CARES) United States, October 1, 2005-December 31, 2010. *Centers for Disease Control and Prevention MMWR, 60*(8), 1-19. Retrieved from http://www.cdc.gov/mmwr/

Neumann, P.J., Jacobson, P.D., & Palmer, J.A., (2008). Measuring the value of public health systems: the disconnect between health economists and public health practitioners. *Am J Public Health, 98*, 2173-2180. doi: 10.2105/AJPH.2007.127134

Neumar, R.W., Barnhart, J.M., Berg, R.A, Chan, P.S., Geocadin, R.G., Luepker, R.V., Newby, L.K., Sayre, M.R., & Nichol,G. (2011). Implementation strategies for improving survival after out-of-hospital cardiac arrest in the United States: consensus recommendations from the 2009 American Heart Association Cardiac Arrest Survival Summit. *Circulation, 123*, 2898-2910. doi: 10.1161/CIR.0b013e31821d79f3

Nichol, G., Valenzuela, T., Roe, D., Clark, L., Huszti, E., & Wells, G.A., (2003) Cost effectiveness of defibrillation by targeted responders in public settings. *Circulation, 108*, 697-703. doi: 10.1161/01.CIR.0000084545.65645.28

Pell, J.P., Sirel, J.M., Marsden, A.K., Ford, I.,Walker, N.L., & Cobbe, S.M., (2002). Potential impact of public access defibrillators on survival after out of hospital cardiopulmonary arrest: retrospective cohort study. *BMJ, 325*, 515-517. doi: 10.1136/BMJ.325.7363.515

Rea, T.D., & Page, R.L., (2010). Community approaches to improve resuscitation after out-of-hospital cardiac arrest. *Circulation 121*, 1134-1140. doi: 10.1161/CIRCULATIONAHA.109.899799

U.S Census Bureau, (2010). *Village of Evendale Census.* Retrieved from http://www.census.gov

Weisfeldt, M.L, Griffith, C., Aufderheide, T.P, Davis, D.P., Dreyer, J., Hess, E.P., Jui, J., MacQuarrie, A., Malonet, J.P., Morrison, L.J., Nichol, G., Ornato, J.P., Powell, J., Rea, T.D., & the ROC Investigators, (2007). Abstract 1810: bystander administered AED shock improves survival from out of hospital cardiac arrest in US and Canada.

Circulation, 116, 385-II_386. Retrieved from http://circ.ahajournals.org/cgi/content/meeting_abstract/116/16_meetingabstracts/II_385-d

Winkle, R.A., (2010). The effectiveness and cost effectiveness of public-access defibrillation. *Clin Cardiol. 33*(7), 396-399. doi: 10.1002/clc.20790

APPENDIX 1 – SURVEY INSTRUMENT

Evendale Fire Department

Automated External Defibrillator (AED) Survey

This survey's purpose is to discover AED programs currently operating in Evendale. It will also assess need for programs in targeted businesses in accordance with accepted parameters. If your business has multiple locations, please base your answers on the Evendale location only.

Please circle (or place an "x" next to) the appropriate answer.

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1) How many employees does your business have?
   a. 1-25
   b. 26-50
   c. 51-100
   d. >100

2) How many employees are on site during normal business hours?
   a. 1-25
   b. 26-50
   c. 51-100
   d. >100

3) How many people (including clients) are typically in your business during work/open hours?

   a. 1-25
   b. 26-50
   c. 51-100
   d. >100

4) What percentage of employees (estimated) are over age 50?

   a. 0-25%
   b. 26-50%
   c. 51-75%
   d. 76-100%

5) Do you have employees trained in cardiopulmonary resuscitation (CPR)?

   a. Yes
   b. No (proceed to question 7)

6) If you run multiple shifts, are CPR trained employees available on each shift?

   a. Yes
   b. No
   c. Sometimes
   d. We only run 1 shift

7) Are you familiar with the purpose and benefits of Automated External Defibrillators (AEDs)?

   a. Yes, I know a lot about AEDs

   b. Yes, I know a little about AEDs

   c. I know what they are, but do not know how they would benefit me.

   d. Unfamiliar

8) Do you know the cost of an AED?

   a. Yes

   b. No

9) Does your facility currently have an (AED) on site?

   a. >1

   b. 1

   c. No (end of survey)

10) What type (brand and model) of AED do you have?

   a. _____

11) Do you have employees trained in AED use?

   a. Yes

   b. No

12) Is the AED accessible to employees and clients?

a. Employees

b. Clients

c. Employees and clients

d. Other, please specify_____

APPENDIX 2 – SURVEY RESPONSES

Evendale Fire Department

Automated External Defibrillator (AED) Survey

Responses are noted in parentheses ( )

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1) How many employees does your business have?

   a. 1-25 **(20)**

   b. 26-50 **(8)**

   c. 51-100 **(7)**

   d. >100 **(10)**

2) How many employees are on site during normal business hours?

   a. 1-25 **(23)**

   b. 26-50 **(11)**

   c. 51-100 **(4)**

   d. >100 **(7)**

3) How many people (including clients) are typically in your business during work/open hours?

   a. 1-25 **(16)**

   b. 26-50 **(12)**

c. 51-100 **(8)**

d. >100 **(9)**

4) What percentage of employees (estimated) are over age 50?

a. 0-25% **(26)**

b. 26-50% **(15)**

c. 51-75% **(2)**

d. 76-100% **(1)**

5) Do you have employees trained in cardiopulmonary resuscitation (CPR)?

a. Yes **(35)**

b. No (proceed to question 7) **(9)**

6) If you run multiple shifts, are CPR trained employees available on each shift?

a. Yes **(9)**

b. No **(10)**

c. Sometimes **(2)**

d. We only run 1 shift **(20)**

7) Are you familiar with the purpose and benefits of Automated External Defibrillators (AEDs)?

a. Yes, I know a lot about AEDs **(21)**

b. Yes, I know a little about AEDs **(14)**

c. I know what they are, but do not know how they would benefit me. **(9)**

d. Unfamiliar **(4)**

8) Do you know the cost of an AED?

a. Yes **(18)**

b. No **(28)**

9) Does your facility currently have an (AED) on site?

a. >1 **(6)**

b. 1 **(14)**

c. No (end of survey) **(27)**

10) What type (brand and model) of AED do you have?

(Medtronic, Zoll, Heartstream, Physio, Mastertrak, Defib Tech, and Powerheart.)

11) Do you have employees trained in AED use?

a. Yes **(19)**

b. No **(0)**

12) Is the AED accessible to employees and clients?

a. Employees **(8)**

b. Clients **(0)**

c. Employees and clients **(10)**

d. Other, please specify_____ **(0)**