How to evaluate cost-effectiveness of your AED program

You will no doubt be wondering whether it is worth spending time and money on a program designed to improve early defibrillation capabilities in your community. It's true—no one can put a price on a life. If only one life is saved, the effort was worthwhile—especially if the survivor is someone you know personally. But when it comes to making decisions about community programs, it's important to understand and articulate the financial effect of these decisions. To become an effective advocate of defibrillation readiness in your community, you need to know the cost of implementing an early defibrillation program and the number of lives that are likely to be saved. In other words, it is important to understand cost-effectiveness.

Cost-effectiveness analysis is a method used to determine the value of a medical intervention. Although the process can be complicated, there are certain fundamentals.

Here is the basic formula:

Cost per life saved = Cost of the program / Number of lives saved

Since many AED program costs simply are modest additions to an existing budget, it is important to only include these "incremental costs." Most cost-effectiveness analyses are "adjusted" in terms of how long a person lives after being resuscitated (average years of survival).

The modified formula is:

Cost per life year gained = Incremental costs of the program per year / Number of lives saved x average number of years survival

**Figuring out incremental costs**

First, it is necessary to figure out the incremental costs of the program.

The incremental yearly costs of a community's early defibrillation program include:

- Device costs (divided by the expected life of the device in years)
- Peripheral equipment costs (divided by the expected life of the equipment in years)
- Annual maintenance and insurance costs
- Annual AED training costs
- Annual incremental salary costs of program personnel
- Annual event documentation costs
• Annual quality assurance costs
• Annual additional community-wide CPR training.

Incremental costs vary widely from community to community. It's important to recognize that in every community, only the additional costs directly related to the AED program should be considered for the cost-effectiveness analysis. Let's take a closer look.

Device costs

Ideally, your community should plan to place enough AEDs to ensure that no more than five minutes elapses from the time the 9-1-1 call is made until the first shock is delivered. To do this, you will have to consider the size and general health of your population and the area of your community in square miles. The average cost for an AED is $3,000. Some AED manufacturers and distributors provide lease-to-own options, which cost approximately $200 a month per AED over a three-year period. Some communities use devices that have been donated or purchased through grants and gifts. Manufacturers expect AEDs to last up to five years.

Peripheral equipment costs

In addition to the costs of the devices themselves, you need to consider the costs of AED accessories such as extra batteries, electrode pads and cables. The costs of these accessories total approximately $500 per defibrillator. Some AED models also require battery chargers, which cost about $200. This equipment will last up to five years with normal use.

Maintenance and insurance costs

Maintenance costs vary according to the type of device. The primary costs associated with maintenance involve replacement of batteries and electrode pads. For each device, you should have two batteries so that you always have a spare. Lead acid batteries, which cost about $150, have to be replaced about every two years. Lithium batteries, which cost about $100 to $300, have to be replaced every one to five years, depending on the capacity of battery and usage patterns. Pads cost approximately $20 a pair. At least two sets should be kept on hand for each AED because they are discarded after use. Unused pads should be replaced after two years because they slowly dry out over time. Replacement insurance and warrantee and service contracts may need to be purchased from some manufacturers.

Training costs

Costs associated with training may include the following:

1. Instructor fees
2. Student fees (e.g., wages for in-service hours or overtime)
3. CPR manikins, which range in price depending on the sophistication of the model (basic torso models cost about $500);
4. AED trainers, which cost from $400 to $1,000, including accessories
5. Computer cards that are inserted into the AED allow it to function as a training simulator and cost approximately $200
6. Educational materials (e.g., videos, educational booklets)
7. Electrode pads
8. Rental or purchase of audiovisual equipment (optional).

Salaries of program personnel

The chief costs in nonvolunteer EMS systems are the wages and benefits of EMS personnel. Your community may have designated emergency responders in place (e.g., EMTs, firefighters, police officers) who simply will be adding
defibrillation skills to their repertoire of emergency response capabilities. Instructors and administrative support staff may already be available to facilitate this change. As a result, wages and benefits often become negligible factors when figuring incremental costs of early defibrillation programs. Defibrillation is now considered a basic skill for EMTs and may become a basic skill for firefighters, police and other public safety personnel in the near future.

Salaries may or may not be a factor to consider in your community. Some communities have volunteer responders and so incur no salary costs. Others have to pay salaries to responders, instructors and administrative support staff.

**Event documentation costs**

Each time a cardiac arrest occurs, the key time points and clinical variables should be entered into a database. This allows an understanding of system performance and an evaluation of the effect of any system changes. The responder must faithfully document this information shortly after the arrest. This usually is considered part of the responder's job. Then, someone must enter the case information into a computerized database. The cost of time dedicated to data entry should be calculated as a program cost.

**Quality assurance tools**

Communities that invest in improvements in early defibrillation capabilities should take the time to evaluate the impact of this investment on survival. This means consistently collecting data on each and every case of out-of-hospital cardiac arrest. Sometimes a local EMS agency or another agency in the community will maintain the database. Other times, the information will be sent to a central EMS database, perhaps at the state or regional level. Communities should consider how they will monitor data. Data management hardware and software may need to be purchased. All AED manufacturers offer data management software programs compatible with their devices. These cost about up to $1,000. Administration of data collection and generation of reports will require someone's time. This time must be included in the budget.

Lack of technological resources should not hinder a community from proceeding with an early defibrillation program. In some systems, case data is simply recorded on paper forms and forwarded to the appropriate data management agency. It is better to proceed with a rudimentary data management system than to delay until the community can afford more sophisticated methods.

**Community-wide CPR training**

Another factor to consider is the cost of training the local community in CPR. A strong CPR program aiming to have about 50 percent of the adult population trained in CPR will help increase the number of survivors and the effectiveness of the entire program. If community energies are spent promoting CPR awareness and education, most CPR training costs can be endured by individuals, who pay a small fee for a short CPR course or a learn-at-home video or computer-based program. A strong community-wide CPR program increases effectiveness while adding minimally to the community AED budget.

**Taking financial support into account**

When you estimate the incremental costs of your community's early defibrillation program, keep in mind that in some communities, the incremental costs of the early defibrillation program are offset by device donations, loans, grants and contributions. If you already know you have financial support for your program, be sure to take this support into account.

*For example*
Let's work through an example. Let's say your community has a generally healthy population of 76,000* (an estimated 50,000 adults) and an area of 33 square miles*. You decide that to ensure AED application and use in less than five minutes, you will need 12 AEDs*. These will cost about $3,000 each or $36,000 total. In addition, you will need accessories and consumables for your AEDs that total $75 per AED*. You estimate that maintenance costs will average $100 per AED* annually.

Since those who will be using the AEDs are already part of an organization with program personnel in place, there are no salary costs. You estimate that the annual additional cost for program management will be $10,000*.

The selected AED trainer costs $1,000. For approximately 100 police officers on 12 police cars, the initial training costs $100* per officer and the refresher training costs $35* per officer every four months (three times in 12 months) for a total of $20,500.

Since the organization in your community that will be using the AEDs already has a computer and modem and since data management software comes with the AEDs you have purchased, there are no additional costs for quality assurance tools. A part-time person (10 percent) will enter the information and administer the database for an annual cost of $5,000.

*This example is based on actual costs for setting up an early defibrillation program in Rochester, MN. Actual numbers are marked with an asterisk. Other figures are estimates.

In conjunction with your AED program, you plan to increase citizen CPR training in the community and aim to train an additional 15,000 citizens over the next five years. You estimate that citizens themselves will bear the minimal individual costs for training and the community will focus on awareness and promotion. You budget $10,000 toward CPR promotion.

Your community's annual incremental costs are estimated as follows:

- AED costs (divided by five years) $7,200
- Consumables ($75 per AED) $900
- Annual maintenance costs ($100 per AED) $1,200
- Annual program management costs $10,000
- Annual cost of AED trainer ($1,000 over five years) $200
- Annual training budget $20,500
- Salaries of responding personnel $0
- Community-wide CPR training $10,000
- Quality assurance personnel $5,000
- Total $55,000

**Potential effectiveness**

You must now estimate how many lives can realistically be saved in one year. Here is how to estimate this number. The average annual incidence of sudden cardiac arrest is about one case per 1,000 adults. An estimated 60 percent of cardiac arrests are witnessed by someone. (Because they are witnessed, the chance of survival improves tremendously, since the Chain of Survival can be set in motion more rapidly.) This means that for every 1,000 adults in your community, 0.60 cases of witnessed cardiac arrest would occur each year. About one-half will be in the shockable rhythm of ventricular fibrillation if an AED is applied within the first few minutes of arrest.

Let's apply this formula to your community. Review the chart below. How many life years could your community gain with an early defibrillation program?
Survival predictions if "call to shock" time is five minutes or less

The number of survivors in your community depends on whether CPR and defibrillation are initiated in a timely manner. Let's assume that your community establishes two primary goals:

- To ensure that bystander CPR is provided in at least half of all cases
- To ensure that the "call to shock" time is five minutes or less in 90 percent of cases

If your community can achieve these goals, you can expect an estimated 45 percent of victims in witnessed ventricular fibrillation to survive and leave the hospital. By conservative estimates, they will live an average of three more years.

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Your Community

**Figuring out the cost per life year gained**

Now you can figure out the cost-effectiveness. Divide the incremental costs you calculated by the life years gained.

Formula:

\[
\text{Cost per life year gained} = \frac{\text{Incremental costs of the program per year}}{\text{No. of lives saved} \times \text{average number of years survival}}
\]

Example: For 50,000 adults and costs of $55,000:

Agency and community cost per life year gained = $55,000 / 20.3 = $2,709

Thus, in our example, the agency and community cost per life year gained is about $2,709.

This example is simplistic. It depends on certain cost assumptions. Naturally, these will vary with the circumstances in each community. Nevertheless, this information can help you respond confidently to important questions about the value of community programs.

What does the cost per life year gained mean? When comparing the cost of saving lives through an effective defibrillation program in your community, you will find that it compares favorably to other community programs. Our example does not include all comprehensive costs to society. It does, however, include the most important factors in your community—lives saved balanced against extra costs to the community.

Formal and comprehensive cost-effectiveness analysis is much more complicated. In addition to the figures above, it includes all costs of subsequent medical care and the altered income of survivors. These calculations are then compared to other health programs such as kidney dialysis or large-scale prevention programs.
The cost of each life year saved in your community will vary depending on the overall EMS system and population density. Incremental costs in urban or suburban centers with existing potential first responders will be modest in relation to potential lives saved. More sparsely populated rural areas will have difficulty providing very rapid defibrillation even with AED-equipped first responders such as firefighters and police officers. The costs in rural areas will be much higher per life saved. Many communities fall between these extremes. If they are committed to attacking sudden cardiac arrest, they can have successful and cost-effective programs.

Some programs have not demonstrated extra survivors. This does not mean the concepts of early CPR and early defibrillation are invalid, but rather that there are system or execution problems. Since these programs are ineffective, they are not cost-effective. To ensure cost-effectiveness, it’s essential to look at the whole system and address all the links in the Chain of Survival.

**Summary**

To become an effective advocate of defibrillation readiness in your community, you need to know the costs of implementing an early defibrillation program and the number of lives that are likely to be saved. This section provides a method for calculating program costs and predicting survival rates. Only the additional costs directly related to the AED program should be considered for the cost-effectiveness analysis. These incremental costs can be divided by the predicted number of lives to be saved times the average number of years of survival to calculate what it will cost the community for each life year gained. Well-planned AED programs that address the entire Chain of Survival are generally cost-effective, especially when compared with other public health initiatives.