

## Can You Find an AED If a Life Depends on It?

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Every year, approximately 300 000 Americans have an out-of-hospital cardiac arrest, and survival rates are dismal—approximately 6.4%.<sup>1</sup> Automated external defibrillators (AEDs) can restart the heart and provide life-saving audible cardiopulmonary resuscitation (CPR) instructions to aid victims. For patients with ventricular fibrillation, rapid defibrillation with CPR can improve chances of survival to more than 50%.<sup>2–4</sup> AEDs can be easily and effectively used by untrained laypersons and are located in public places such as airports, recreation centers, banks, casinos, churches, gyms, and schools.<sup>5</sup>

Despite the life-saving potential of AEDs, they are of no value if they cannot be located and brought to the victim. Further, there is no US map of AED locations, nor do we even know where all the AEDs are located. Devices are purchased by distributors who then sell them on the Internet, in bulk, or individually. AED registration is the responsibility of the device owner, and the requirements and process differ significantly by region. The Food and Drug Administration has recently highlighted how the lack of registration data makes device recalls and surveillance for potential adverse events challenging. Additionally, this creates a barrier to the use of AEDs when they are needed. Imagine bystanders assisting the resuscitation of a victim in a public area, unaware that an AED is located less than 100 feet away inside a nearby store. They have called 911, and the local emergency medical service personnel are en route, but the emergency dispatchers do not realize that an AED is nearby. The very limited time frame for defibrillation success is certainly more likely to be achieved if those bystanders not providing CPR could be guided to a device that had been previously located and mapped. The problem is easy to understand, and the solution is easy to imagine. Indeed, once AEDs are located and locatable, all sorts of other opportunities arise.

### Envisioning an AED Map

In theory, bystanders during an emergency in some public places will find the location of an AED when they see a displayed AED sign with a red heart and lightning bolt blaze. Unfortunately, these usually wall-mounted devices may be walked past daily and yet never sufficiently register in memory to be recalled when needed. With current technolo-

gies, we can do better. Imagine instead an Internet and mobile-media based nationwide map of those devices. Such a Google-style map could easily be read from a smart phone application that would automatically note the location of the rescuer's phone and the location of nearby AEDs to direct the rescuer to the nearest one. This application (app) could be preloaded on the phone or the information could be embedded in other apps used routinely to locate resources, people, or directions. A bystander calling 911 could also be directed to an AED located by emergency dispatchers: "Emergency medical personnel are on their way. Continue chest compressions. There is an AED in the nearby bookstore, just at the checkout register. If available, send someone who is not performing chest compressions to retrieve the AED."

Use of an app to locate an AED might also be used to enhance other aspects of emergency care through linkage surveys or other assessments designed to systematically evaluate AED use: Was there a real arrest? Was an AED deployed? Did it function? These and other questions—perhaps including those about later psychological stress among bystanders—could populate a nationwide database to support resuscitation epidemiology. Opportunities to investigate this kind of community health care are more challenging without the ability to locate AEDs.

As helpful as maps may be in revealing where the AEDs are located, from a public health perspective they may be at least as helpful in revealing where they are not located. The American Heart Association recommends that AEDs should be within 3 minutes of an arrest victim, and, by that standard, there are certainly innumerable "AED deserts" where no device is present. Whereas fire suppression equipment is ubiquitous in certain buildings, blanketing the nation with AEDs may be costly and implausible. Maps of where arrests are more likely (based on population demographics, time of day, or activity) might be overlaid with maps of AED location and prior bystander use of AEDs to identify these deserts and suggest new placements and more effective deployment. Future studies are needed to evaluate if health systems should focus on improving access in AED deserts or optimizing existing locations and actual use.

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### Populating an AED Map

Approximately 1 million AEDs have been sold in the United States in the past 20 years, and locating each one that is installed at a location precisely enough to create a useful public map presents a challenge. The challenge seems short term, however. New AEDs could be equipped with geographic transponders and effectively become, self-locating. However, before that happens, how do we find all the installed AEDs currently in public locations?

A new approach to overcome this challenge would be to use “crowd sourcing,” a method whereby the public becomes engaged in broad community data collection. The science of crowd sourcing suggests that because the task is offered to an undefined, large group of individuals, it engages those who are interested in addressing the specific problem, who are likely to complete the task, and, in some cases, who contribute with the most pertinent and novel ideas. Examples of crowd sourcing include scientists successfully engaging the public to participate in online gaming to fold proteins (ie, Foldit, Fold.it) to develop drug therapies for HIV and cancer.<sup>6</sup> The project Galaxy Zoo has also successfully harnessed the talents of more than 250 000 online volunteers to better characterize galaxies and generate new astronomy science. There are many major public health challenges that might be investigated with crowd sourcing—harnessing the power of collective thinking to unlock the solution to a problem (eg, universal health care access, malnutrition problems in the United States, and immobility problems in the elderly).

A contest or gaming framework could help motivate a systematic scavenger hunt for the nation’s AEDs, with prizes for the most AEDs located or the most AEDs that have also been located by other teams (to create an internal validation of location—perhaps the only thing worse than not knowing an AED is nearby is wasting time searching for an AED that is not there at all). Crowd sourcing along with traditional methods could be used to ensure that device locations are periodically updated.

The crowd sourcing technique was used by the DARPA Network Challenge (DNC)—a contest to find 10, 8-foot, red balloons moored in parks across the contiguous United States.<sup>7</sup> The first person to report the correct location of all 10 balloons would receive a prize. A distributed human sensor approach modeled around social networks was considered an innovative and novel technique for addressing the challenge. A team of faculty, researchers, and students identified the 10 balloons in less than 9 hours. The speed with which the DNC was solved offers a quantitative measure for the effectiveness of emerging new forms of social networking and crowd sourcing in engaging and assembling teams to address an important and challenging task. The DNC highlighted that with the proper incentives, whether they be financial, academic, or fostering a greater public or community good, today’s “networked society” is eager to come together virtually to solve a challenge and to innovate. When this challenge pertains to the American public health system and the well-being of our citizens, the response could be equally powerful, if not greater.

Mobile phones equipped with cameras could be used to photograph AEDs, using formats with automatically geo-

graphically encoded information; these could be e-mailed to an AED database registry. Mobile apps could further facilitate this process, allowing individuals to record and transmit annotations about location (eg, the AED is on the 10th floor next to the north elevators). Similar data could be electronically transmitted through microblogging sites (eg, Twitter), social networking sites (eg, Facebook), location-based service applications (eg, Foursquare, Gowalla, BrightKite), or other broadly used, Internet-based sites that allow for rapid information transmission and receipt.

Several existing innovative apps are beginning to facilitate this exchange of AED information, but, for their optimal use, we still need a high percentage of inclusion of the current devices, up-to-date locations across diverse geographic regions, and nonproprietary integration with 911 computer-aided dispatch software. Synergy of these apps and broader coverage would help with development of a national registry with data entry maintained by local crowd sourcing and traditional data collection. An app with only AED location data probably would have limited uptake. Because there are currently more than 500 000 mobile apps, widespread access to AED location data will require integration and linkage of this information with regularly used apps that provide information such as weather reports, Internet access (eg, WiFi maps), directions (eg, Google Maps), medical care (eg, first aid instructions), and nearby resources (banks, supermarkets, and parking lots). Also needed are evaluations of how these novel technologies affect outcomes and a continued focus on the chain of survival—improving bystanders’ recognition of cardiac arrest and willingness to initiate resuscitation therapies.

Decades of work confirms that AEDs can save lives, and they have been widely distributed in public places. Because 20% of arrests occur in public locations, the next phase in optimizing AED implementation is in improving access and use of existing devices. Simply having devices installed is not enough—they must be easily locatable. In the same manner that the public increasingly relies on phones to provide information about nearby stores, restaurants, and gas stations in their surroundings, there are opportunities to use phones and networks to locate and share information about relevant emergency devices (eg, AEDs) in times of need.

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