Cardiopulmonary Resuscitation and Public Access Defibrillation in the Current Era—Can We Do Better Yet?

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The paper in this edition of JAH by Iwami, et al. entitled “Outcomes of Out-of-Hospital Cardiac Arrest by Public Location in the Public-Access Defibrillation Era”1 offers very encouraging data with regard to the improving outcomes of out-of-hospital cardiac arrest. The information solidifies and emphasizes strategies in our attempts at the continued improvement in survival with good neurologic outcomes in this condition. In this population-based observational study in Osaka, Japan, consecutive OHCA patients who had resuscitation attempts during a 7-year period from January 2005 to December 2011 were assessed. The public use of automated external defibrillator (AED) was legalized in Japan in July 2004, just before the time period of this study. One of the intents of this paper was to better delineate the outcomes of out-of-hospital-cardiac arrest (OHCA), specifically by location. Trends in public access AED use and 1-month survival with good neurologic outcome were therefore evaluated by location in this study. A total of 9453 episodes of bystander-witnessed OHCA of cardiac origin were documented during the 7-year prospective period, 894 (9.5%) occurred in public places. Interestingly and importantly the proportion of public access AED use increased significantly from 0% (0/20) in 2005 to 41.2% (7/17) in 2011 at railway stations and from 0% (0/7) in 2005 to 56.5% (13/23) in 2011 at sports facilities, for example. Among all who received shocks with public access AEDs the mean time from collapse to shock was 5.0 minutes. In this study it was also very exciting to note that the proportion of patients with good neurologic outcome was 28% (33/118) at railway stations, 51.6% (48/93) at sports facilities, 23.3% (20/86) at public buildings, and 41.9% (13/31) at schools. A multivariate analysis of the data in this study showed that early defibrillation, whether by bystander lay rescuer or emergency medical personnel, was associated with neurologically favorable outcomes to a significant degree.

This paper along with much additional evidence demonstrates that the institution of the “chain of survival” early in the setting of OHCA will result in increased survival and improved neurologic outcomes.2 The chain of survival includes: (1) immediate recognition of cardiac arrest and activation of the emergency response system, (2) early cardiopulmonary resuscitation (CPR) with an emphasis on chest compressions, (3) rapid defibrillation, (4) effective advanced life support, and (5) integrated post-cardiac arrest care. Several important aspects of the institution of this chain of survival especially with regard to lay rescuer involvement are important to emphasize. Those critical aspects include the actual recognition of the cardiac arrest, the institution of lay rescuer CPR as well as the proper use of public access defibrillation.

The findings of the Iwami paper are indeed outstanding and show some very important new information. Most critically it highlights the importance of lay rescuer impact on OHCA and it provides an encouraging model for continued work in the United States as well as the rest of the world. Several important aspects of public education with regard to lay rescuer institution of the chain of survival should be emphasized.

1. Recognition of cardiac arrest and institution of “the chain” is critical. Therefore, it is important that lay rescuers understand and have the ability to recognize some of the important nuances of cardiac arrest. For example, in the educational process it is important to continue to emphasize that a seizure could be a manifestation of cardiac arrest. In addition, agonal breathing, sometimes not so easily recognized as being abnormal by lay-public observers, may also be mistaken as normal respirations. In either case the recognition of these signs as a potential manifestation of cardiac arrest is important and should alert the lay rescuer to do CPR rather than be reassured that CPR is not necessary.
2. It should be emphasized that good quality CPR is a critical part of public access AED use and must be instituted immediately and interrupted only when absolutely necessary. This is supported by multiple experimental studies that show much improved cardiac output as well as coronary perfusion in the setting of continuous uninterrupted CPR compared with CPR that is interrupted for various reasons. Compression-only CPR for adults has been recently instituted in the United States. The early data suggest that this will not only result in a higher incidence of lay rescuer CPR but will also lead to improved outcomes both because of the higher incidence of lay rescuer-initiated CPR but also because the CPR will be uninterrupted and will be of higher quality with a resultant optimization of organ perfusion, especially with regard to cerebral blood flow. More data on these outcomes will be forthcoming. Interestingly in Japan compression-only CPR by lay rescuers has been in place only since 2010.

The authors make a point of discussing where optimal placement of public access defibrillators should occur. For example, in the Osaka, Japan study railway stations were the most common places where shocks associated with public access AEDs were delivered. In the United States and other western countries shocks by public access AEDs have been more common at sports facilities, airports, and amusement facilities such as casinos, for example. In Japan the annual total number of railway passengers was ≈27.6 billion in 2011. Because of the sheer volume of railway users in Japan further promotion of public access defibrillator programs for railway users is critical. The American Heart Association issued a statement with regard to the guidelines for the location of public access defibrillators. There are some data available on the location of cardiac arrests in larger metropolitan areas. For example, in Seattle and King County the incidence of cardiac arrest is greatest at the international airport, county correctional facilities, shopping malls, sports venues, industrial sites, golf courses, shelters, ferry and train terminals, health clubs, and senior centers.

The sites of optimal PAD placement or most frequent cardiac arrest sites are likely to vary by community. Therefore, to optimize the placement of this limited health care resource the specific communities in question will need to be examined in order to determine the location of the highest incidence of cardiac arrest. In fact, the AHA has recommended the establishment of PAD programs at sites in which:

1. The frequency of cardiac arrest is such that there is a reasonable probability of AED use (event rate of one sudden cardiac arrest per 1000 person-years)
2. EMS call-to-shock time of <5 minutes cannot be achieved
3. EMS call-to-shock time interval <5 minutes can be reliably achieved (in >90% of cases) by training and equipping lay persons to function as first responders in the community EMS system, recognizing cardiac arrest, phoning 911, initiating CPR, and operating an AED.

The study reported by Iwami, et al also documented very interesting outcomes associated with OHCA at schools. In their study 80% of OHCA events at schools had ventricular fibrillation as the first documented rhythm, 67% received a public access AED shock in 2010 and 42% had neurologically favorable outcomes. Of note is the important fact that previous studies had indeed documented that OHCA at schools occurred more frequently than expected. In the Iwami paper it is documented that the school PAD program has contributed favorably to the improving outcomes of both the teachers and the students. In our own experience with Project ADAM, instituted in November of 1999 after the sudden cardiac arrest of several young, asymptomatic athletes in the Milwaukee area, we have disseminated CPR-AED education across the state of Wisconsin and additionally have established affiliate programs in 10 states thus far (Figure). The ultimate goal has been to: (1) place CPR-AED programs in every school in the United States, (2) advocate for and insure that all students learn CPR-AED use prior to graduation from high school so that we establish a standard for a community well versed in instituting lay-rescuer CPR, and (3) partner with any and all organizations in the community in order to achieve these goals. Project ADAM has been a resource for schools across the country to implement CPR-AED programs. Although we have not achieved the goal of having CPR-AED programs in every single school yet, thus far 80 total saves in teachers as well as students have occurred across the United States as a result of school CPR-AED programs. Therefore, we agree wholeheartedly that the dissemination of CPR education and public access AEDs at schools is essential and that further studies to investigate incidences and other characteristics of OHCA, including details about past medical history, is essential in both preventing OHCA as well as in improving the outcomes in schools as well as in other venues, particularly as it might relate to the childhood and adolescent age group.

It is also interesting that at least one public access AED has been deployed in almost all schools in Japan. Such is not yet the case in the United States. In the United States, deployment of school CPR-AED programs targeted for both students and teachers is warranted in order to shorten the time to shock and improve OHCA (32), as in Japan. The Science Advisory Council of the American Heart Association has established this as a recommendation in 2011 (32). It has been well documented that the school continues to be a site where a multitude of individuals, young and old, congregate and pass through at any given time including the use for after
hours athletic events as well as other community-oriented activities. It has been estimated that on any given day almost 20% of a local community passes through its schools (32). In addition, mandatory CPR-AED education for all students prior to graduation, as recommended by the American Heart Association,11 will train a community of individuals who are willing and able to go into the community and perform lay rescuer CPR when indeed as alluded to above. Such a scenario also has the potential to increase survival and improve outcomes from OHCA.

In summary, this prospective study in Osaka, Japan is incredibly encouraging and offers optimism for the future in the setting of outcomes after OHCA. Without question we are improving but can we do even better yet? Older data suggested that both the incidence of lay rescuer CPR12 as well as the OHCA survival13 was incredibly low with both figures in the 7% to 20% range in several studies. Therefore, the public access AED/lay rescuer intervention rate of 41% at railway stations and 56% at sporting events with 28% and 56% survival, respectively, reported in Iwami’s paper, is very encouraging. However, is this intervention rate and outcomes profile good enough? Again, we must ask, can we do better? Is it possible to achieve an intervention rate of close to 100% and to what degree might the outcomes of OHCA be improved in such a scenario?

This study could and should be a stimulus to go forward with the aims towards education and implementation. Continued endeavors towards the goal of teaching high quality-public CPR has the potential to position all citizens for early intervention with the rapid institution of the chain of survival. Such strategies have and should continue to include mass training events as well as advocacy for CPR-AED education in the schools as a mandate or at least as part of the educational curriculum in all schools. The latter strategy, the requirement that all students learn CPR-AED use prior to graduation, will ultimately position each and every citizen for the ability to understand and implement the chain of survival. In addition, the placement of public access defibrillators in key locations is critical. The sites chosen may vary by geographic location. Better assessment of the optimal sites as well as implement-
tation of placement of devices will be critical in our efforts at increasing survival from OHCA.

Progress in this field is palpable and exciting. Greater opportunity for early intervention with excellent quality intervention and improving outcomes is possible. This paper offers encouraging data but we must not become complacent by its results. Rather, we should aim high knowing that continued education, implementation, and analysis will allow us to improve outcomes even further. Perhaps we can achieve a near 100% early intervention with excellent quality CPR-AED implementation. This will most certainly allow for even greater OHCA survival with good neurologic outcomes.

Disclosures
None.

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