

Mandating automated external defibrillators in schools: Fire, ready, aim!

Lance Brown, MD, MPH

SEE ALSO PEDIATRIC EM SECTION, PAGE 428.

In this issue of the *Canadian Journal of Emergency Medicine*, Drs. Valani, Mikrogianakis, and Goldman present a very nice review of cardiac concussion, also known as commotio cordis.¹ Their review has brought to mind recent events regarding the only known effective treatment for cardiac concussion: prompt defibrillation.^{2,3} As an emergency physician and father of young children who play sports, I can vividly imagine the suffering of parents who have seen their child sustain a modest blow to the chest with a ball, collapse and die. I am highly motivated to prevent such tragedies and to promote effective treatments for those unfortunate times when these events cannot be prevented.

Since 2001 there have been efforts in the United States to introduce state legislation requiring schools to provide public access defibrillation programs with onsite automated external defibrillators (AEDs). As a parent, I find it rather appealing to have equipment available at school that might save the lives of children, possibly my own. From the perspective of public health, however, it is not intuitive to me that having AEDs in schools would be an effective public health measure. Well-respected groups have made recommendations that are confusing to me — for example, recommending AEDs in schools with “a documented need.”⁴ Given that I have never seen a school-aged child who has experienced cardiopulmonary arrest at school present while I was on duty in the emergency department, I’m not sure there are a sufficient number of sudden, unexpected pediatric cardiac arrests to allow a typical school to determine if they have “a documented need.” I suspect

these events are very rare. Nonetheless, assessing the potential public health impact of mandating schools to have public access defibrillation programs needs to be based on more than my personal experience. This involves understanding the history behind efforts to develop school-based public access defibrillation programs and estimating the costs and potential benefits of these programs for an entire community.

Pediatric AED development

Before May 2001, available AEDs delivered voltages considered unsafe for children less than about 8 years of age. Small-animal studies from the 1970s and 1980s suggested that voltages >10 J/kg were injurious to the developing myocardium.^{5,6} Standard AEDs deliver voltages between 150 and 360 Joules, which would make them inappropriate for children lighter than 15 to 36 kg (the weight of typical preschool and young school-aged children). In May 2001, the US Food and Drug Administration (FDA) granted permission to the Heartstream Operation of Agilent Technologies, Inc. (subsequently sold to Philips Medical Systems) to market a specially modified AED for use in children younger than 8 years of age.⁷ The primary modification of this AED was the development of pads and cables that delivered substantially less voltage than standard AEDs, thereby making them safer for young children.

The Pennsylvania offer and the New York mandate

By the end of May 2001, the same month that the FDA ap-

Department of Emergency Medicine, Linda University Medical Center, Loma Linda, Calif.

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proved the marketing of pediatric AEDs, the state legislature of Pennsylvania approved funding to make pediatric AEDs available to every school district in the state on a voluntary basis. One year later, in May 2002, the New York State government took a different approach, and the Governor signed legislation *requiring* every school to have an AED available and ready for use by the end of that year. Although I am not aware of any other legislature mandating the placement of AEDs in schools, it appears that governments have reviewed legislation regarding school-based AED public access defibrillation programs in other states including California, Delaware, Georgia, Illinois, Maine, Massachusetts, New Jersey, Rhode Island and Virginia.⁸ I am not aware of similar governmental activity in Canada at this time.

There are meaningful differences between the approaches of the Pennsylvania and New York state legislatures. In Pennsylvania, school districts could elect to receive the AED and subsequently elect to maintain it and maintain a staff trained to use it. In New York, the state dictated that all schools would have and maintain AEDs for an indefinite period. Therefore, even if preliminary funding were provided to supply the first AEDs, school districts would endure an unfunded mandate to maintain functional AEDs and assure the daily presence of appropriately trained staff to use them should the need arise. This cost has been estimated to be nearly US\$8000 for the first year and US\$3000 per year for subsequent years.⁴ These cost estimates are primarily dependent on the cost of the AED and the need for hiring substitute teachers during teacher training periods.

The rarity of unexpected, sudden pediatric cardiac arrest on school grounds

In the last few months, the first data have become available that specifically address the epidemiology of unexpected, sudden pediatric cardiac arrest at school. Since there is no mandatory and centralized reporting mechanism for these deaths in the US or in Canada, the true incidence of unexpected, sudden pediatric cardiac arrest on school grounds in these countries is unknown. I believe the best evidence currently available is from the Ontario Prehospital Advanced Life Support (OPALS) study, a study of 21 urban–suburban communities with a combined population of approximately 3 000 000 served by 1641 elementary and secondary schools.^{9–11} There are currently 2 abstracts published from the OPALS study data that focus on school-based public access defibrillation. The first abstract was published in *Academic Emergency Medicine* in May 2004.¹⁰ In this analysis, the authors reviewed 5 years of

cardiac arrests in the OPALS study population. Twenty-three cardiac arrests occurred in elementary and secondary schools during the study period. Most of these individuals were older adults (mean age 57 yr), only 2 were children (ages 11 and 15 yr). Both pediatric arrests occurred during exercise. The second abstract was published in *Emergency Medicine Australasia* in June 2004.¹¹ In this analysis, the authors reviewed 8 years of pediatric cardiac arrests in the OPALS study population. Of the pediatric cardiac arrests during this time, only 3 occurred in schools. These 2 abstracts provide the first community-based data of which I am aware specifically delineating the epidemiology of unexpected, sudden pediatric cardiac arrest at school.

Cost of AEDs in schools

Based on the published OPALS data, we can perform a preliminary analysis of the costs of AEDs in schools. For the 1641 schools in the OPALS study, the cost — calculated and presented here in US dollars — to initiate a school-based public access defibrillation program with 1 AED per school is \$13 128 000 ($1641 \times \8000). Each subsequent year would cost \$4 923 000 ($1641 \times \3000). So, based on the 5-year analysis, the total cost to the OPALS communities would be \$32 820 000 ($\$13\,128\,000 + [4 \times \$4\,923\,000]$). This represents an average of \$1 562 857 per community and an average of \$1 426 967 per cardiac arrest when both adult and pediatric cardiac arrests are included in the analysis. Based on the 8-year analysis, the cost would be \$47 589 000 ($\$13\,128\,000 + [7 \times \$4\,923\,000]$). This represents an average of \$2 266 143 per community and \$15 863 000 per pediatric cardiac arrest.

These cost calculations are probably reasonable rough estimates but are very sensitive to changes in the cost of an AED, the number of cardiac arrests observed in the schools, and the number of AEDs deemed necessary to achieve specific time-to-defibrillation goals at a particular school. A relatively large school would need multiple AEDs to meet time-to-defibrillation goals, because the athletic field, playground, cafeteria, gymnasium, administrative offices and classrooms could be separated by substantial physical distances.

Benefits of AEDs in schools

Although there are case reports of the effective use of AEDs in pediatric cardiac arrest¹² and experimental animal data supporting AEDs for treating pediatric cardiac concussion,¹³ I am not aware of any data suggesting that a school-based public access defibrillation program would be an effective public health measure. In the absence of outcome data, one useful exercise might be to estimate the frequency

with which each AED might be used to attempt to save a life at a school. This could give a rough estimate of the benefit each school might expect from purchasing an AED.

We can make these estimates with data from the OPALS study. Since there were 23 cardiac arrests in adults and children over 5 years in 1641 schools, the expected frequency with which each AED could be expected to be used to treat someone is once every 357 yr [(1641 schools × 5 yr) / 23 cardiac arrests].¹⁰ Since there were 3 cardiac arrests in children over 8 years in 1641 schools, the expected frequency with which each AED could be expected to be used to treat a child is once every 4376 yr.¹¹ The odds that a single school population would experience 2 of these events are exceedingly small, making the likelihood of a school having “a documented need” for an AED very problematic.

Conclusion

Schools should not be mandated to have public access defibrillation programs with onsite AEDs at this time. Just because appropriate AEDs are now available for children does not mean that public access defibrillation programs in schools will be effective. Given the timing of the legislation in both Pennsylvania and New York, I strongly doubt that the legislation was based on any study of the utility of AEDs in schools. Before other regional governments follow New York State in mandating that schools have public access defibrillation programs, further study is needed. When considering mandating AEDs in schools, we need to take a step back and make sure that we put “ready,” “aim” and “fire” in the proper order.

Competing interests: None declared.

Key words: chest trauma; pediatric; commotio cordis; resuscitation; defibrillation

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Correspondence to: Dr. Lance Brown, Division of Pediatric Emergency Medicine, Department of Emergency Medicine, A-108, Loma Linda University Medical Center and Children’s Hospital, 11234 Anderson St., Loma Linda CA 92354; fax 909 558-0121, LBROWNMD@aol.com