



Availability of Automated External Defibrillators in Public High Schools

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Objectives To assess automated external defibrillator (AED) distribution and cardiac emergency preparedness in Michigan secondary schools and investigate for association with school sociodemographic characteristics.

Study design Surveys were sent via electronic mail to representatives from all public high schools in 30 randomly selected Michigan counties, stratified by population. Association of AED-related factors with school sociodemographic characteristics were evaluated using Wilcoxon rank sum test and χ^2 test, as appropriate.

Results Of 188 schools, 133 (71%) responded to the survey and all had AEDs. Larger student population was associated with fewer AEDs per 100 students ($P < .0001$) and fewer staff with AED training per AED ($P = .02$), compared with smaller schools. Schools with >20% students from racial minority groups had significantly fewer AEDs available per 100 students than schools with less racial diversity ($P = .03$). Schools with more students eligible for free and reduced lunch were less likely to have a cardiac emergency response plan ($P = .02$) and demonstrated less frequent AED maintenance ($P = .03$).

Conclusions Although AEDs are available at public high schools across Michigan, the number of AEDs per student varies inversely with minority student population and school size. Unequal distribution of AEDs and lack of cardiac emergency preparedness may contribute to outcomes of sudden cardiac arrest among youth. (*J Pediatr* 2016;172:142-6).

Sudden cardiac death (SCD) is responsible for 5%-10% of all deaths in children 5-19 years of age and 75% of sudden deaths among young athletes.¹ Although most large population studies have excluded persons less than 18 years of age, racial disparities in the incidence of sudden cardiac arrest and SCD across multiple age strata have been reported.^{2,3} State-wide studies of SCD in Michigan for people aged 1-39 years old show an age-adjusted mortality of 5.5 per 100 000 individuals, with significant differences by county, sex, and race. Males experienced two-thirds of all deaths.⁴ Black males had the highest age-adjusted mortality of 16.5 per 100 000, and white males had an incidence of 6.1 per 100 000.⁴ Importantly, the reasons behind these differences in the incidence of SCD are unknown.

Public access defibrillation (PAD) is the main tool for secondary prevention of SCD. The American Heart Association has promoted lay rescuer automated external defibrillator (AED) programs since 1995, and the Public Access Defibrillation trial demonstrated that the use of AEDs by lay individuals increased survival to hospital discharge.⁵ Survival rates of up to 71% have been reported in schools.⁶ Increased survival is associated with bystander cardiopulmonary resuscitation, timely on-site AED deployment, and the presence of cardiac emergency response plans.^{7,8} At least 1 in 73 high schools will have a sudden cardiac arrest on campus each year.⁶

The incidence of out-of-hospital cardiac arrest (OHCA) in persons 14-24 years of age is approximately 1.44 per 100 000 persons.⁹ The most common causes of sudden cardiac arrest in this age range include congenital anomalies and primary arrhythmia.⁹ OHCA in schools is notable for a higher incidence of shockable rhythm (ventricular fibrillation, ventricular tachycardia) and a higher likelihood of survival compared with OHCA in other locations.^{6,10} Only a handful of studies have assessed factors associated with AED distribution and cardiac emergency preparedness in schools. Prior studies have revealed significant variation in the distribution of AEDs and cardiac emergency response plans at the school level by school population size and school location.¹¹⁻¹³ The association between school sociodemographic indicators and AED-related factors, including distribution and training, has not been investigated. In the State of Michigan, there is only limited public funding for AED placement and training.

The objective of this study was to describe the school-based distribution of AEDs, AED-trained individuals, AED maintenance frequency, and cardiac emergency response plans in Michigan public high schools. Further,

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Supported by the Division of Pediatric Cardiology, University of Michigan Congenital Heart Center. The authors declare no conflicts of interest.

Portions of the study were presented as a poster at the meeting of the Pediatric Academic Societies, San Diego, CA, April 25-28, 2015.

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<http://dx.doi.org/10.1016/j.jpeds.2016.02.010>

AED	Automated external defibrillator
OHCA	Out-of-hospital cardiac arrest
PAD	Public access defibrillation
SCD	Sudden cardiac death

associations between these AED-related factors and school characteristics including size and sociodemographic attributes were evaluated.

Methods

This was a cross-sectional survey study of the distribution of AEDs, AED-trained individuals, AED maintenance frequency and cardiac emergency response plans in Michigan public high schools. Of the 83 counties in Michigan, 30 counties were randomly selected from 3 population tertiles based on county population, resulting in ten counties each of small (<25 000), medium (25 000-75 000) and large size (>75 000). Charter schools, alternative schools, and single-sex schools were excluded. This study was deemed exempt from regulation by the Institutional Review Board of the University of Michigan.

The number of AEDs on each school's property was reported by a school representative who self-identified as having adequate information to answer the study questions. An AED-trained individual was defined as someone with documented AED training, either as part of Basic Life Support certification or an AED-specific training course.

School-specific sociodemographic data were collected from publicly accessible data published by the Michigan Center for Educational Performance and Information for the 2012-2013 school year. These include the number of students per school, proportion of students classified as minority, and proportion of the students eligible for free or reduced lunch. A minority student was defined as African American or Black, American Indian, Native Hawaiian, Hispanic, or multiracial. Schools were designated as small (<600 students), medium (600-1500 students), or large (>1500 students) as defined by prior education policy studies.^{14,15}

A brief online survey was designed using Qualtrics (Qualtrics, Provo, Utah) to collect information on the number of AEDs on campus and their location, the number of AED-trained individuals and their specific training, and the presence of a cardiac emergency response plan. Additional questions were included regarding the job designation of the respondent and whether the school had ever held a cardiac emergency response drill.

A representative for each school within the 30 counties was identified by contacting school administrators via e-mail. Administrators then identified themselves or another staff member as an appropriate contact regarding AED location and training. Surveys were sent via e-mail to the school representatives from May 2014 to October 2014. School representatives received weekly reminder e-mails throughout the study period in addition to follow-up phone calls. Individuals who completed surveys received compensation of \$5 via a mailed gift card.

Statistical Analyses

Study data were described as frequency with percentage for categorical variables and median with IQR for continuous variables. School and sociodemographic characteristics were compared between survey respondent schools and nonrespondent schools, using χ^2 test for categorical variables and Wilcoxon rank sum test for continuous variables. Similar comparisons were made for the associations between AED-related factors and school sociodemographic characteristics. All analyses were performed using SAS v 9.4 (SAS Institute, Cary, North Carolina). A *P* value of <.05 was considered statistically significant.

Results

Of 188 schools, 133 (71%) responded to the survey (Table I). Respondent schools and nonrespondent schools were similar in size and sociodemographic characteristics, with the exception that respondent schools had a lower proportion of students eligible for free or reduced lunch (*P* = .01).

The majority of survey respondents were either school administrators (54%) or school nurses (11%). Other respondents included athletic trainers and administrative assistants (Table II). All schools reported at least 1 AED on school property. The majority of schools (71%) reported 1-3 AEDs, most commonly located in the gym, cafeteria, hallway, or an indoor or outdoor athletic facility. There was an average of 5 trained staff members per AED.

Fewer than one-half of schools (47%) reported having a cardiac emergency response plan. Approximately one-quarter of

Table I. Comparison of respondent and nonrespondent schools

Characteristics	School responded to survey*		P value†
	Yes (N = 133)	No (N = 55)	
School population			
Small (<600 students)	85 (63.9)	36 (65.5)	
Medium (600-1500 students)	44 (33.4)	16 (29.1)	.84‡
Large (>1500 students)	4 (3.0)	3 (5.5)	
Proportion of students of minority race/ethnicity, %	6.9 (5.0-11.4)	7.2 (4.4-12.2)	.92
Number of schools with >20% of students of minority race/ethnicity	20 (15.0)	10 (18.2)	.59
Proportion of students eligible for free or reduced lunch, %	45.1 (32.3-55.7)	52.3 (37.0-60.6)	.06
Number of schools with >50% of students eligible free or reduced lunch	46 (34.6)	30 (54.5)	.01

*Data are presented as N (%) for categorical variables and median (IQR) for continuous variables.

†P value from χ^2 test for categorical variables and Wilcoxon rank sum test for continuous variables.

‡Comparison of small vs medium or large; P value from χ^2 test.

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