Aiming for Zero Deaths: Prevention of Sudden Cardiac Death in Schools
– Statement From the AED Committee of the Japanese Circulation Society –

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1. Why Should a Life-Saving Program Be Introduced Into Schools?
With the extensive deployment of automated external defibrillators (AEDs) in schools, cases of successful life saving of children after sudden cardiac arrest have been increasingly reported in Japan. On the other hand, in spite of the presence of AEDs in school, there are children who lost their lives for lack of use of the device. After the loss of Asuka Kirita, a 6th grade student in Saitama City, Japan, who suddenly died after long-distance running and the AED in her school was not used, a textbook on fast response to life-threatening accidents occurring during activities such as a physical education class was formulated with the collaboration of the family of the deceased and the staff of the Municipal Board of Education in Saitama City after learning this tragic lesson.¹

There is a reasonably high possibility of increasing survival once the life-saving program of the emergency response to sudden cardiac arrest has been introduced and is well in place.² In fact, 4 of 5 victims (80%) of cardiac arrest were reportedly successfully rescued during the 2005 World Exposition held in Aichi Prefecture, where AEDs were made extensively available every 300 ms. We also note the 100% survival achieved during the annual Tokyo marathon race where 7 of 7 runners survived after cardiac arrest, with the efficient contribution of the bike squad carrying AEDs. Survival after sudden cardiac arrest is reportedly higher in the young generation (Figure 1).³ Even higher survival rates can be expected in school where the chances of a cardiac arrest being witnessed and in the midst of young people on site are high. This can be accomplished by careful preparation as well as daily training and the introduction of an emergency teamwork program for life saving. This statement addresses our goal of zero sudden cardiac deaths in schools by proposing approaches for the school not to repeat tragedies involving the young and to prompt action to save precious lives.

2. Chest Compressions and Use of AEDs Are Mandatory for Saving Lives From Sudden Cardiac Arrest in School
Many school children have heart disease of both congenital and acquired etiologies. Based on the analysis of collected cases of cardiac arrests (excluding those from accidents such as commotio cordis) occurring in elementary and middle schools, approximately half of the victims had been followed for heart disease, but in the remaining half, no heart disease

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had been diagnosed prior to the event. Moreover, because there are a substantial number of commotio cordis cases in which ventricular fibrillation develops after an accidental blow to the chest, most frequently with a hard ball thrown at school or in the playground, it is almost impossible to predict the tragic event. According to the analysis cited above, which excluded cases of commotio cordis, in 97% of the cases of cardiac arrest in school the event was witnessed, in 84% of the cases the subject received chest compression, and a school AED was used in 38% of cases. As a result, 72% of the victims were rescued and survived for at least 1 month. As ventricular fibrillation was recorded in 94% of the cases, the survival rate would have been even higher if use of an AED was more thorough and timely at the scene for earlier termination of ventricular fibrillation. A 100% survival rate is not a dream but a real target well achievable through developing and intensifying life-saving programs in schools comprising rapid defibrillation using AEDs, which are placed in every elementary/middle/high school, combined with chest compression to circulate blood to critical organs both before and after defibrillation. Note: the role of AEDs in schools may be even greater in view of the high incidence of cardiac arrest among adults such as teaching staff. In contrast, as the incidence of cardiac arrhythmic arrest among preschool children is relatively rare, installation of AEDs in kindergartens or nursery schools may not be mandatory. If an AED is provided in such facilities, which has reportedly saved a life on rare occasions, pediatric pads should be prepared for children under 6 years, but not for those who are older.

3. Where and How Should AEDs Be Placed in Schools?

School AEDs are sometimes placed in the sick bay, teacher’s office or clerk’s office, but more strategic placement of AEDs is advisable so that they are easily accessed from potential sites with a higher incidence of cardiac arrest (Figure 2). In addition, the presumption is more likely that a student, not a teacher, will run to get the AED.

According to the analysis cited above with commotio cordis excluded, 84% of cardiac arrests in schools occurred in locations closely linked to sports activities such as the playground, swimming pool, or gymnasium. As commotio cordis also tends to develop during sports activities, placement of AEDs in such locations is strongly recommended. It is also advised that AEDs should be available 24 h, weekdays and holidays for unexpected cardiac arrest occurring during club activities after school. There has to be a person in charge of the maintenance of AEDs who is responsible for replacing worn-out batteries and electrode pads.

Recommended Locations for AED Installation in Schools

(1) AEDs should be placed in well-marked locations that students can readily see everyday (http://www.j-circ.or.jp/aed/arrow/).

   eg, entrance lobby, corridor wall near the nurse’s/teacher’s office

(2) Locations reached within 1 min run from anywhere in the school.

If it takes more than 1 min for a single person to get and another 1 min to bring it back, call somebody else to bring it, or install more than one AED within the school so that it will not take more than 2 min to get ready for defibrillation.

(3) Locations with good access from sports facilities such as the playground, swimming pool, or gymnasium. Sites where the AED may be exposed to rain or extreme heat or coldness should be avoided.

(4) AEDs should be positioned unlocked with 24-h availability all-year round.

(5) AEDs can be moved to prepare for emergencies at unusual sites during special events such as sports day or interschool matches.

   Rental AEDs should also be available for irregular events.

(6) Extra AEDs should be available at training camps or away matches.

(7) AEDs should be preferably ready for rental to citizens in the neighborhood in case of emergency.

For strategic placement of AEDs in general, please refer to the sites listed below (in Japanese):

http://www.jhf.or.jp/aed/arrangement.html
http://www.mhlw.go.jp/stf/houdou/0000024514.html

4. Training in Life-Saving Techniques for Staff and Demonstration of Emergency Teamwork

More than 3-fold regional differences in neurologically favorable survival have been demonstrated following pediatric out-of-hospital cardiac arrest in Japan. This regional variation derives from multiple factors including differences in the popularization of prehospital care for pediatric out-of-hospital cardiac arrest, which is far less frequent than adult cardiac arrest. It is important for the school staff to understand the following: (1) sudden cardiac arrest can occur in school; (2) the keys to successful rescue are hands-on teamwork at the scene and effective timing of each step of the “chain of
survival”; (3) a high survival rate can only be achieved by improving these key components.

As exercise-related sudden cardiac arrest is common in school, it is recommended that physical education teachers in addition to school nurses should play a key role in preparing and promoting a life-saving program in each school. All staff are recommended to take a course in life-saving practice. Invited coaches should also be notified about the risk of children’s sudden cardiac arrest and are advised to take a similar class and training. Lectures are usually provided in classes but simulation training at each place of playground, swimming pool, and gymnasium is also practical and useful.

It is also recommended to create a Code Blue Alert or emergency communication system. Specifically, all staff are advised to carry their cell phones at all times, having them handy during the physical education class. Every staff member should be aware of the emergency contact number to call just in case, and a school public address system should also be ready for use in such emergencies.

Emergency response is provided by bystanders, each of whom has a specific role in the life-saving process. All people in a school should be aware of their potential roles. Below is an example of the steps taken when someone collapses in school, which can be modified to accommodate situations and create an original protocol specific to each school.

Witness A and Bystanders
(1) If somebody has suddenly fallen to the ground and responses (consciousness) are not regained within 10 s and without normal breathing, cardiac arrest should be suspected. If one is uncertain, start action assuming it is cardiac arrest.
(2) Ask someone on site to give help and make a 119 call.
(3) Make an emergency call to person B in charge of rescue, asking for help and an AED if it is located nearby.
(4) Start chest compression.

Person B in Charge of Rescue
(1) Check the clock time.
(2) Confirm if 119 call has been made, and AED has been sent to the scene.
(3) Tell the first responder A that B is coming to the scene immediately and B will make a 119 call if it has not yet been made (while A keeps giving chest compression).
(4) Rush to the scene and assist with chest compression. Do not send a stretcher.

Switch the cell phone setting from contact talking to public talking using a speakerphone so that one can talk over the 119 center while continuing cardiopulmonary resuscitation (CPR).

Other Staff Members C and D
The third person C on the scene may contact teacher D in charge of the victim’s class, and go to the school gate to await the ambulance and guide the paramedics to the scene.

Teacher D gathers information on the victim: name, medical history, names of the doctor and the hospital in charge. At the same time, D tries to contact the parent(s) of the victim and inform them of what has happened. And lastly, notify and report to the school principal of the event and the ongoing process.

5. Detection and Daily Management of High-Risk Children to Prevent Sudden Cardiac Arrests and Prepare for an Emergency
Regular health checkups in school are crucial to the early detection of heart disease possibly leading to sudden cardiac arrest.

In addition to medical history and physical examination, an electrocardiogram (ECG) may give important clues to pinpointing high-risk children.

• Specific ECG abnormalities: hypertrophic cardiomyopathy, congenital heart disease, myocarditis, long QT syndrome, WPW syndrome
• No specific ECG abnormalities: Kawasaki disease, coronary artery anomaly, catecholaminergic polymorphic ventricular tachycardia, etc.

Characteristically, high-risk children with no specific ECG abnormalities may present with sudden cardiac arrest during exercise, whereas those with specific ECG abnormalities and under medical control may suffer cardiac arrest either during exercise or at rest. For the latter group of children, it is recommended to discuss restrictions required for daily activities and the probability of use of an AED with the doctor in charge.

Due attention must be paid to symptoms children are complaining of, such as chest pain, palpitations or faintness, particularly associated with exercise. Make every effort to keep children in good shape, and let them see a doctor when considered necessary.

Every time a high-risk child becomes a student of the school, do the following:
• Share the name and the meaning of any heart disease. Determine the initial actions to take on emergency. Notify staff accordingly.
• Ready relevant information to be relayed to doctors at the emergency hospital, such as name of the disease, medical and family history, drugs prescribed and drugs considered to be a contra-indication, name of the doctor in charge, name of parent(s).
• Information on the restriction of daily activities regarding exercise or swimming, for example, must be shared not only with teachers but the school doctor and parent(s).

6. Educating Children on How to Save a Life
It is best not only for teachers but also children to learn CPR at school for 3 reasons.

(1) CPR is not always provided by teachers to children. The collapse from cardiac arrest is often witnessed by children at the scene. Moreover, it is possible that sudden cardiac arrest victims can be teachers or parents visiting a class rather than school children. Proper actions can be provided sometimes more rapidly by children than by adults.

(2) Every year, there are more than 75,000 out-of-hospital sudden cardiac arrests of cardiac etiology. Children, if well trained and capable of doing proper CPR, can play a key role in life-saving both inside and outside school. Their potential contribution to helping sufferers from a disaster will be critical. By learning CPR repeatedly from childhood, they will be able to keep their important skills after becoming adult members of society.

(3) By learning how to save somebody else’s life during childhood, one will gain sympathy for others – their life, a spirit of cooperation, and recognizing their own value.
Lectures and CPR training of children is recommended as part of important compulsory education for all school children as well as college students.

**Subject**
For the fourth grade of elementary school or higher.

**Instructor**
The instructors will be teachers with the cooperation of school doctors, nurses, or paramedics, if available.

**Curriculum**
- Variable according to age and developmental stage.
- Content should include diagnosis of cardiac arrest, 119 call, chest compression, use of the AED.
- Hours of each class will best be fitted into the usual lesson time of 45–90 min.
- Practice should be a priority with sufficient time devoted, using simple mannequins or many alternative devices or tools for hands-on CPR.
- Practical tips should include confirmation of the precise location(s) of AEDs in the school.
- Practical training should take place in such areas as the playground, swimming pool, and gymnasium, in addition to classes.

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**References**