Guidelines for Optimal Placement and Accessibility of Public-Access AEDs

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JAPAN FOUNDATION FOR EMERGENCY MEDICINE

The authors have no conflicts of interest with companies or for-profit groups associated with the content of the guidelines.

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Purpose of the English version of the guidelines

The Japanese version of these guidelines were first published in 2013 and revised in 2018. Since its first publication in 2013, the guidelines have had an impact on Japanese society by bringing awareness to community members and systems that the strategic installation and management of automated external defibrillators (AEDs) is a public responsibility of our community members, including local governments, organizations, companies, and each citizen. An English version of the guidelines are, therefore, necessary to help non-Japanese people living in Japan to understand this responsibility.

When we were making this English version, we recognized that some words concerning the specialty of resuscitation science needed interpretation, for example, “comotio cordis,” which refers to the status of cardiac arrest caused by a specific situation. This is a sudden lethal cardiac arrhythmia such as ventricular fibrillation caused by a blunt, non-penetrating impact on the precordial region of the chest wall. Young people are particularly susceptible to this pathophysiological condition. Therefore, this term is extremely important in the guidelines. However, there is a need for translation for readers those who do not have a medical background. In addition to the term concerning the specialty of resuscitation sciences, words in Japanese daily use are also needed in specific comments. For example, “Koban” is a special word and concept in the Japanese policing system. It refers to a neighborhood police outpost that has been developed over many years in Japan. Koban has been recognized as an effective Japanese policing system that is deeply rooted in local communities. Therefore, installing AEDs in Koban is a reasonable option in Japanese communities. This information might be important to non-Japanese residents living in Japan. For this reason, we created a short glossary of these terms in the first part of the English guidelines. The guidelines do not guarantee that AEDs will be set at every facility mentioned. These AEDs are sufficiently installed in many facilities, such as schools. However, it is difficult to install AEDs in other areas due to financial constraints.

We expect that after the Covid-19 pandemic, the guidelines will be shared with people and specialists for resuscitation sciences and widely shared with persons in charge of public health. Sharing the guidelines among administrators in various countries might trigger discussion on this important issue for every community.

Japan Foundation for Emergency Medicine
Special Committee on the Use of AEDs by Non-Healthcare Workers
Working Group on AED Installation Standards

Glossary

Medical Terms

Onsite AED
AED not dispatched by ambulance crew but set up in a place where cardiac arrests are likely to occur.

Out-of-hospital cardiac arrest
Occurrence of cardiac arrest in an individual outside of hospital.

BLS
Basic life support
The type of care that first-responders provide to anyone who is experiencing cardiac arrest.

CPR
Cardiopulmonary resuscitation
The artificial substitution of heart and lung action as indicated for cardiac arrest. Chest compression and ventilation are major components of CPR.

Compression-only CPR
The combination of chest compression and mouth-to-mouth breathing has been recommended for a long time for the standardized BLS procedure. Compression-only CPR refers to CPR procedure without breathing. Some epidemiological studies concerning resuscitation, particularly from Japan, show that there is no difference between CPR with mouth-to-mouth breathing and CPR without breathing in BLS with regard to the outcomes of out-of-hospital cardiac arrests.

Commotio cordis
Sudden cardiac arrest caused by a blunt, non-penetrating impact on the precordial region of the chest wall. It is common in ball games such as baseball and combative sports such as karate. Young people, particularly adolescents, are especially susceptible. Commotio cordis often results in sudden death without prompt cardiopulmonary defibrillation.

Agonal respiration
Agonal respiration or breathing is an abnormal pattern of motion often seen in persons suffering from cardiac arrest. This motion appears in labored breathing and is sometimes misunderstood as effective spontaneous breathing. The presence of agonal respiration in these cases indicates a more favorable prognosis than in the cases of cardiac arrest without agonal respiration because the cardiac rhythm of these cases with agonal respiration is often ventricular fibrillation, which can respond to AED use.

Other Terms

Michi-no-Eki
Michi-no-Eki is a roadside rest area for free parking spaces, restrooms, food, and regional special goods. Tourist information is also provided for drivers and cyclists here. Michi-no-Eki

are located along national highways, not in expressways. Currently, there are over 1,000 such locations throughout Japan.

Service area
In Japan, expressway rest areas are called “Service Areas.” Although equipment varies depending on the facility, most of the service areas have free parking spaces, restrooms, food, free tea, or water services. Tourist information is also provided for drivers. Some service areas include gas stations, electric car stand for fuel, and accommodation for drivers.

Theme park
An amusement park or entertainment park mainly targeting families.

Kominkan
A kominkan is a community center for people who live in that particular community. The word is a Japanese term meaning a public hall for citizens. Such centers are generally supported and administered by local governments. More than 15,000 kominkans are located in both remote areas and urban areas all over Japan. In the event of a disaster, some of them are used as shelters. Kominkans usually provide learning programs in art, sports, cooking, or other cultural activities for people who live in the neighborhoods.

Shimin Kaikan
Shimin kaikan is a civic hall built and managed by the local government to promote cultural activities in the area.

Koban
A Koban is a neighborhood policing outpost for local police services, including responding to incidents and accidents, giving directions to people who get lost, handling lost items, giving advice on security and other concerns, and conducting door-to-door patrols.

Kaigo Fukushi Shisetsu
In Japan, there are several types of care and welfare facilities for elderly people who cannot live alone or need help in their daily life. The types of facilities selected mainly depend on the handicap and needs of users.

Pachinko parlor
Pachinko parlor is a type of mechanical gaming place like a slot machine house for low-stakes gambling. It has become widespread and popular in Japan.

Kyoteijo
Kyotei is a hydroplane racing event that is primarily held in Japan. A Kyoteijo is a place where this boat race is held. People come to see races and bet for races, like what is done in horse races.

Conveni
A Japanese abbreviation of a convenience store (also known as a combini).

Nintei Kodomoen

Nintei Kodomoen is an Early Childhood Education and Care (ECEC) center. It is an integrated facility that can play both the role of day nurseries and of that kindergartens. It has been authorized by central governments since 2006 in Japan.

Hoken-shitsu
A nurse's office in a school, mainly in primary and secondary school. Usually, the school nurse provides care to students when they fall sick or get injured and call their parents if needed. These are the equivalent of student health service centers in universities.

Revised edition 2018

Five years have passed since the first version of the guidelines were published in 2013. The first version was developed to show standards for the optimal placement of AEDs based on scientific evidence. However, the rationale behind these indicators and the circumstances surrounding AEDs have changed over the past five years. In addition, the functions of AEDs have developed and improved. In preparation for the upcoming large-scale national sporting events in Japan, we have made the necessary revisions to the guidelines based on the latest trends.

The purpose of the guidelines

In sudden cardiac arrest cases, it is known that onsite AEDs in public spaces are more effective in saving lives and in influencing the neurological outcome of the survivors than dispatched AEDs that are brought to the scene by emergency crews upon receiving a call. Nevertheless, no specific, well-founded standards have been established for the optimal location and placement of public-access AEDs. Therefore, the guidelines were designed to suggest the optimal location of onsite AEDs intended for use by the general public and to promote the efficient and effective use of AEDs in order to save lives during out-of-hospital cardiac arrests.

We expect that, for those who are planning to introduce public-access AEDs or those who have already been introduced as local governments or private companies, the guidelines would contribute to efficiently and effectively placing or establishing the accessibility of AEDs by referring to the guidelines.

1. Introduction

Since the 1990s, AEDs have been widely used in Europe in the United States. In Japan, the use of AEDs by non-medical personnel was approved for the first time in July 2004, triggered by their installation on aircraft. Since then, however, the number of AEDs installed in public facilities such as train stations, airports, schools, and government offices has increased, and the number of AEDs per population is comparable to that in other advanced countries. Japan is also a leading country in reporting statistics on out-of-hospital cardiac arrests, which have provided objective evidence that these AEDs have saved lives and resulted in better neurological outcomes in many people(1,2). However, among all the cases of sudden cardiac arrests witnessed by the general public, the percentage of AED use cases has remained insufficient. Public access defibrillation (PAD) programs are defined as the management plan to be utilized effectively by bystanders who happen to be near the patient. This kind of PAD program has not been sufficiently well organized and well operated.

There are two main reasons for the low rate of use of AEDs in the event of out-of-hospital cardiac arrests: (1) an AED was installed at the scene of the event but was not used and (2) there were no AEDs in the vicinity of the event. The latter may be due to a lack of accurate numbers of AEDs, a mismatch between the location of cardiac arrest and the location of AEDs, inconsistent local AED deployment standards, lack of public awareness of the location of AEDs, or lack of policy involvement and systematic deployment of AEDs.

Although many efforts have been made to increase the number of AEDs so far, more effective and strategic deployment and management of AEDs should be promoted in the future. In addition, public awareness of the location of AEDs should also be promoted. In 2010, the Japan Emergency Medical Care Foundation established the “Special Committee on

the Use of AEDs by Non-Healthcare Workers" to discuss the effective use of AEDs based on the work of the working group that was working on AED installation standards, the working group on education and dissemination for AED use, and the working group on the utilization and verification of data recorded by AED. As a result of these efforts, an AED location search system was launched in 2007, and the Foundation's national AED map was made available on the Internet in 2015 to disseminate information on the location of onsite AEDs(3). The guidelines were developed by the Working Group on AED Installation Standards of the special committee, and the guidelines summarize the optimal installation and management standards of AEDs. The fundamental framework of the guidelines are motivated by the recommendations titled "Towards Strategic Allocation of AEDs" from the Japanese Circulation Society and the Japanese College of Cardiology in 2012(4). This revised version is an update of the first version based on the accumulation of knowledge and changes in circumstances during the period from the publication of the first version of the guidelines.

2. Facilities where AEDs are required to be installed

(1) Things to be considered when installing an AED

Cardiac arrest varies widely in both frequency and survival rates depending on the location of its occurrence(5,6). Although more than 70% of cardiac arrests occur in homes(7), the rate of witnesses and the frequency of ventricular fibrillation, which is applicable to electroshock, is more likely to be life-saving in public places(7,8). Therefore, public places are considered a promising place for onsite AEDs to be installed, and the installation of onsite AEDs is mainly recommended for these public spaces(9-11).

To apply AEDs effectively and efficiently, it is necessary to consider not only factors directly related to the frequency of cardiac arrests, such as high population density, areas where a large number of elderly residents, particularly those with heart disease, live, and a high risk of cardiac arrest due to exercise or stress, but also the ease of being witnessed and the environment in which rescue is easily obtained.

It is also important to consider that these devices are used in situations where lifesaving is expected for a witnessed person. On the other hand, some places, such as schools, require the installation of AEDs even if the frequency of cardiac arrest is low. Furthermore, in places where it takes a long time for emergency crews to arrive, such as airplanes and remote islands, and in areas where rapid lifesaving treatment is difficult to obtain, such as remote areas where medical care and lifesaving are not easily expected, AEDs should be installed as part of the health services for residents to maintain fairness in lifesaving.

Table 1: Factors to consider in the effective and efficient installation of AEDs

1. High frequency of cardiac arrest (ventricular fibrillation, which is an indication of electric shock, among other things) (more people in general or more people with high risk for cardiac arrests)
2. Social and entertainment events with a risk of cardiac arrest of participants (e.g., baseball ground or baseball stadium with potential risk of the occurrence of commotio cordis, arena, or other areas designated for sporting at high risk of the occurrence of cardiac arrests, etc.)
3. High expectation of a rescue/high frequency of witnessing cardiac arrest (many people, good visibility)
4. It takes a long time for emergency services to arrive (aircraft, remote areas, islands, mountainous areas, etc.)

(2) Guide to installing AEDs from the viewpoint of frequency of cardiac arrest

The condition to consider first when installing AEDs is that they should be placed where cardiac arrests occur most frequently: in large community intervention trials that have demonstrated the effectiveness of PADs, this refers to facilities that have witnessed at least one cardiac arrest every two years or facilities where more than 250 adults aged 50 years or older stay for at least 16 hours per day(13). Based on this evidence, the 2005 European guidelines recommended onsite AED facilities with potential occurrence of at least one out-of-hospital cardiac arrest every two years, such as airports and sports facilities(14). However, it was later changed to recommend locations where more than one cardiac arrest occurs every five years(11). In the United States, locations where more than one cardiac arrest occurs every five years have also been recommended as locations for AED installation(10). It is estimated that such AED installations result in approximately two-thirds of out-of-hospital cardiac arrests(5).

【Facilities where AEDs are recommended to be installed (examples)】

① Stations, airports, long-distance bus terminals, expressway rest areas (service areas), and roadside rest facilities (Michi-no-Eki).

In Japan, it has been reported that cardiac arrest and the use of AEDs are more common in public places, especially at stations where many people gather(15,16), particularly in urban areas, since many people, young and old, gather in the stations. It is desirable to install AEDs at stations where an average of 10,000 or more passengers gather per day. In addition, careful preparation and training of personnel at the stations are essential to ensure that lifesaving treatment can be carried out smoothly even under crowded conditions.

It has been reported that AEDs are necessary at airports for several reasons. In addition to similar conditions at the stations, people are more likely to have a heart attack when exposed to a stressful environment, for example, fatigue after a long flight. The effectiveness of AED installation at airports has been demonstrated in Europe and the United States(18). The installation of AEDs at airports should therefore be actively promoted.

② Long-distance transportation, such as passenger aircraft, long-distance trains, and long-distance passenger ships

In addition to the risk of heart attack associated with fatigue due to long travel, the need for AEDs on passenger planes is high because of the unique characteristics of the aircraft, where it is difficult to obtain help from emergency services because it is isolated from the land world. Several cardiac arrests have occurred on airplanes and the effectiveness of onsite AEDs on airplanes has been proved. Therefore, it is necessary to install AEDs on passenger planes(19,20). Similarly, it is necessary to install AEDs on long-haul passenger transportation facilities such as Shinkansen trains and other express trains, passenger ships, and ferries.

③ Gym and sports-related facilities

Sudden death during sports often occurs in young, healthy individuals (as well as older people). They are also more likely to experience cardiac arrest. The occurrence of ventricular fibrillation is more common in high-intensity sports such as football, swimming, and marathons. In addition, the occurrence of commotio cordis has been

reported to be relatively common in ball sports such as baseball, soccer, and rugby, and also in martial arts such as karate(21-23). It is advisable to install AEDs in facilities where these sports are conducted, such as gyms and grounds with administrative offices and ballparks(17,23-25).

Older players are more common in golf than in other sports, and the incidence of cardiac arrest per golf course facility is as high as 0.1/year(23), which is higher than other types of sports. In addition, golf courses are often located in suburban areas, and it takes longer for an ambulance to arrive at a golf course. Therefore, there is a need to install multiple AEDs on the golf courses to allow for electric shocks within five minutes of the event. The installation of AEDs in these sports facilities should be considered(13,17).

④ Large commercial facilities, including department stores, supermarkets, restaurants, etc.

In addition to traditional department stores, supermarkets, and restaurants, large-scale suburban commercial complexes have become commonplace in Japan. In addition, the number of large drugstores selling everything from daily necessities to over-the-counter medicines has also increased. It is advisable to systematically install multiple AEDs in facilities with more than 5,000 daily visitors (or at least 250 adults at any given time)(13,17).

⑤ Facilities that attract a large number of customers

It is advisable to install more than one AED in amusement parks (Theme Parks), zoos (Dobutsuen), large public entertainment facilities such as beaches (with life guards) (Kaisuiyokujo), ski resorts, large bathing facilities, tourist facilities, and funeral facilities (Sosaijo)(13).

⑥ Relatively large public facilities such as city halls, community centers (Kominkan), and civic halls (Shimin Kaikan).

Cardiac arrests are often experienced at large public facilities. Therefore, it is necessary to educate the public regarding the installation and maintenance of AEDs, in addition to direct life-saving. This might bring public awareness of the importance of the installation and management of AEDs in communities.

⑦ Public facilities located in densely populated areas, such as small police stations (Koban) and fire stations

Public facilities located in densely populated areas should be equipped with AEDs, regardless of the size of the facility or the number of users, from the perspective of saving the lives of local residents.

⑧ Care and welfare facilities for the elderly (Kaigo, Fukushi Shisetsu)

Cardiac arrests frequently occur in old-age facilities with 50 or more residents. The installation of AEDs is therefore advisable in these facilities(17).

⑨ Schools (kindergartens, elementary schools, junior high schools, high schools, universities, vocational schools, etc.)

Sudden cardiac arrest in schools is not limited to children and students, but it also includes adults such as teachers, staff, and community members(27-29). In Japan, it has been reported that 30% of sudden cardiac deaths in children and students are due to cardiac origin, and 30 to 40 cases have been reported per year(30). Schools are one of the facilities where AEDs are required. Most schools in Japan have at least one AED(31), but larger schools need to install multiple AEDs to deliver electroshock within five minutes following an event of cardiac arrest. According to the current survey, the location of AEDs in schools depends on each school.

The majority of sudden cardiac arrests in schools occur during physical education classes and club activities, such as running, swimming, and other exercise loads. Therefore, accessibility to AEDs in high-risk locations such as playgrounds, pools, and near gymnasiums must be considered(32). In addition to school days, AEDs should be available at playgrounds and gymnasiums in the event of cardiac arrests during weekends when facilities are open to residents or children in neighborhoods.

⑩ Companies, manufacturing plants, factories, and workshops

Companies, factories, and workplaces with many employees should consider installing AEDs. For example, it is advisable to install AEDs in places and facilities where 250 or more employees over the age of 50 years work(13).

⑪ Recreational facilities

The risk of cardiac arrest is high at amusement facilities such as horse race tracks (Keibajo), boat race tracks (Kyoteijo), and Japanese game houses with gambling (Pachinko parlors) because of the increased sympathetic nervous function of participants and audience. The highly populated nature of these environments is also stressful for people. In addition, the possibility of cardiac arrests is high. Therefore, the installation of an AED is advisable(17,33).

⑫ Large hotel/convention center

Hotels and convention centers need to have AEDs because of the large numbers of people who gather there and the considerable length of their stay.

⑬ Other

⑬-1 Services that require effective implementation of basic life support

Facilities that are required to provide basic life support using AEDs due to the nature of their services, such as private ambulances, are required to install and offer training on using AEDs.

⑬-2 Remote and underpopulated areas, such as islands and mountainous areas, require the installation of AEDs because of the time required to provide emergency services and medical care.

【Facilities where AED installation is considered (examples)】

① A landmark facility for the community

Depending on local situations, such as covering a large number of people in the community and the time required to provide emergency services, AEDs can be considered for installation in facilities that are easily marked and used by rescuers, such as post offices, banks, 24-hour convenience stores (Conveni), gas stations, and drug stores(34). In recent years, the installation of AEDs in convenience stores by local governments has become more widespread, and cases of full recovery have been reported(35). The installation of AEDs in convenience stores by local governments is recommended because it contributes to the promotion of local PAD programs(36) and to the cooperation between stores and the local government in terms of crisis management(37).

② Nurseries (daycare) (Hoikujo) and early childhood education and care centers (Nintei Kodomoen)

AEDs can be used not only for infants but also for toddlers under one year of age (9-12 months). Larger facilities for infants and toddlers are now installing AEDs(35). If it is difficult for a small nursery to install an AED, it is advisable to ensure the availability of AED in the same building or nearby(36). It is also advisable to improve the subsidy system for the installation of AEDs by local governments. The installation of AEDs for childcare systems outside school for lower-grade children in elementary school must also be considered. A pediatric mode, a pediatric key, or a pediatric pad should be used for preschoolers, but the responsible personnel should not hesitate to use an adult AED if the child cannot respond immediately.

③ Housing complexes

The effectiveness of AEDs is not clear for several reasons: cardiac arrest incidents at home are usually not witnessed, as they sometimes occur when the patients' family members are not present. Sometimes the person living with the patient is sleeping or taking a bath. In other instances, if the family member is present during the incident, he or she is too old to take rescue action quickly and appropriately. However, in Japan, nearly 70% of sudden cardiac arrest cases occur in homes and residences, and since many of these are in apartment complexes, the installation of AEDs is expected to be effective in densely populated environments, such as apartment complexes(6,7).

Some cases have been reported where people at risk of cardiac arrest have been saved by installing AEDs in their own homes, but currently, there are also options such as implantable defibrillators and wearable automatic defibrillators for people at high risk. In situations where someone is expected to be around to perform the rescue, one may consider preparing an AED at home or elsewhere(36-39).

Table 2 : Examples of facilities where the installation of AEDs is recommended

1. Stations, airports, long-distance bus terminals, expressway service areas, and roadside stations (Michi-no-Eki)
2. Passenger aircraft, long-distance trains, long-distance passenger ships, and other long-distance transportation
3. Gyms and sports-related facilities
4. Large commercial facilities, including department stores, supermarkets, restaurants, etc.

5. Facilities that attract a large number of visitors
6. Relatively large public facilities such as city halls, community centers (Kominkan), and civic halls (Shiminkaikan)
7. Public facilities located in densely populated areas, such as police stations (Koban), fire stations, etc.
8. Care and welfare facilities for the elderly (Kaigo Fukushi Shisetsu)
9. Schools (kindergarten, elementary school, middle school, high school, university, vocational school, etc.)
10. Company, factory and workshop
11. Recreational facilities
12. Large hotels/convention centers
13. Other
13-1 Services that require the effective delivery of basic life support
13-2 Remote and underpopulated areas, such as islands and mountainous areas, where emergency services and medical care are not available on time.

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3. How to install an AED in the facility

According to a study on the actuality and effectiveness of AEDs in Japan, AEDs installed in public spaces that delivered electroshocks within an average of three minutes of cardiac arrest resulted in a full recovery rate of nearly 40%(1). A delay of one minute in the delivery of electroshocks reduced the full recovery rate by 9%. It has been shown that increasing the installation density of AED from one AED per 1,000 m^2 to one AED per 500 m^2 increases the recovery rate by four times(1). At the Aichi World Expo, 100 AEDs were installed at 300-meter intervals. In four of the five cardiac arrest cases that occurred on the grounds of the Expo, four were rescued with the intervention of AEDs. A Copenhagen study recommends that AEDs should be installed at 100-meter intervals in residential areas(6). Another study in Japan showed that it takes two to three minutes for public citizens to call 119 (including recognizing and starting to act) after witnessing a cardiac arrest(40). It is important to note that the outcome of an out-of-hospital cardiac arrest depends on the person who happens to be present at the scene of the incident. Therefore, it is necessary to encourage the use of AEDs in these situations if we expect a high life-saving rate. It is, therefore, advisable to install AEDs to shorten the time to administer electroshock as follows.

(1) For the majority of witnessed cardiac arrests, it is advisable to have an AED accessible within five minutes of the occurrence of the incident. For this purpose, AEDs in the facility should be placed in easily accessible locations. For example, since exercise-related cardiac arrest is common in schools, the placement of AEDs in exercise facilities should be prioritized over school nurses' offices (Hoken-shitsu).
(2) AEDs should be placed in easily visible locations in the facility so that they can be easily identified, and signs or signboards indicating their location should be posted as appropriate.
(3) All staff at the facility where the AED has been installed must know the exact location of the AED in the facility.
(4) It is desirable for everyone to be able to have 24-hour access to the AED. If there is limited time for AED use, information on the availability of AEDs should be provided(44). A case has been reported during an administrative inspection that the AED was locked in a box, thus limiting the availability of the AED.

(5) It is also important to design an indicator that shows that AED is working, which can be easily recognized and inspected on a daily basis. It is also important to place AEDs in an environment where it is safe to break considering the influence of high temperatures in summer and low temperatures in winter, wind, and rain.

Table 3: Factors to consider when deploying an AED in a facility

1. Placement in which electroshock can be delivered within five minutes following a cardiac arrest
   - Placement at a density of less than one minute each way from the site
   - Placement near elevators and near stairs in high-rise buildings, etc.
   - In large factories, systems that enable the AED manager to reach the location of the AED directly, or save time by using a bicycle, motorcycle, or other means of transportation.
2. To make it easy to understand the location of the AED (near the entrance, where it can be seen always and where many people pass through, with a prominent sign)
3. Accessibility to everyone (no locks or guards or certain people who are authorized to use it at all times)
4. Placement near a place where there is a risk of cardiac arrest (such as a playground or gymnasium) (Undojo, Taiikukan)
5. To show the location of AEDs to the public (displaying the AED location map on the facility map, indicating the AED location floor on the panels in an elevator, etc.)
6. Placement of AEDs in a safer environment and in an environment where the AED manager can manage the AEDs easily

4. Management of AEDs and disclosure of deployment information

For the AED to be effective, the following is required:

(1) An AED at any facility should be set up and maintained by a person in charge, and the equipment should be maintained regularly.

(2) To ensure the smooth use of AEDs, the purpose of the AED installation and the responsibilities of the person in charge should be clearly defined, and arrangements for emergency response should be put in place.

(3) It is advisable that local governments obtain information on the installation of AEDs in the area to serve and to promote the proper placement of AEDs. It is also advisable for local governments to provide information on AEDs in relevant areas according to the AED map operated by the Japan Foundation for Emergency Medicine or local governments and to provide information to residents (consideration should be given to providing the information in a form that allows anyone to access and reuse it).

Local governments that do not have AED installation information or do not have their own AED map should provide information to their residents by linking to the webpage of the national AED Map of the Japan Foundation for Emergency Medicine and creating an AED map for their own area in which prefectural and city offices are located. If an AED map has already been prepared for the community, the community leader should promote the installation of more AEDs by obtaining information from the Japan Foundation for Emergency Medicine, with the approval of the AED provider to give out the information about AEDs to local governments. This might help to improve the AED map(45).

(4) AED installations should be actively registered, information on AED installations should be published, and AED inventory information should be made available to the public upon

the request of local governments.

(5) Many local governments and universities offer services to lend AEDs for various events, including sporting events. Local governments and educational institutions should give greater consideration to such lending systems.

(6) When AEDs are used, as part of the role of the local emergency medical system, the local medical control council (liaison council of emergency hospitals and fire stations) should verify the ECG data at the time of AED use. Facilities with AEDs should provide this information about AED use to fire stations and medical institutions upon request from the medical control council.

5. Other situations where AEDs are required to be installed and deployed

In addition to the installation of AEDs in the facilities described above (which are on-site AEDs), it is also recommended that a single AED be used effectively in a wide area, for example, by equipping a police car (Pato Car) or fire truck (Shobosha) with an AED, depending on the situation of the relevant area(43).

AEDs are also required to be deployed in environments where the risk of sudden cardiac arrest is a concern, such as the following:

(1) Large-scale marathon event

Although the incidence of sudden cardiac death associated with physical activity and exercise is lower than the incidence of sudden cardiac death at rest because people spend a longer time resting during the day, it is known that the risk of sudden cardiac death increases during high-intensity exercise(44). Among the categories of exercise and sports, a marathon is reportedly the most likely sport to cause sudden cardiac death. The first version of the guidelines reported that the risk of cardiac arrest during a marathon was 0.5 cases/100,000 participants(46). However, it was later reported that the risk was 1.53 cases/100,000 participants for the Tokyo International Marathon(47). This large scale of civil participatory marathons has become very popular, but related to this, many cardiac arrests have been reported. It is thought that the risk of cardiac arrest has increased in the recent large-scale marathon events compared to the traditional athlete-centered marathons due to the wider range of participants. In fact, it has been reported that many more cardiac arrests have been observed compared to past events, and the number of survivors has been increasing, returning spontaneous circulation through the use of AEDs(46-48). When conducting these events, it is necessary to ensure that AEDs are available throughout the event and not just at a specific spot. In large-scale marathon events with more than 5,000 participants, a mobile AED system using not only fixed-point placement but also a concurrent vehicle or bicycle team would be useful. In the Tokyo International Marathon, nearly 90% of the cardiac arrests witnessed in the marathon were in a state of agonal respiration in which the cardiac rhythm suggested ventricular fibrillation and were treated through electroshock using AEDs. It has also been reported that agonal respiration is often mistaken as a sign that the patient is still breathing and not in cardiac arrest; therefore people tend not to use the AEDs. This causes a delay in the delivery of electroshock. Preventing such a delay of defibrillation for a person in agonal respiration is very important(47).

(2) Commotio cordis (Shinzo Shinto: Concussion of the heart)

In competitions such as baseball, karate, soccer, and rugby, where balls and people collide with each other, sudden cardiac deaths from commotio cordis (Shinzo Shinto) have been noted to account for 20% of all sudden deaths in young people during exercise. In some competitions, the use of chest protectors is mandatory as primary prevention from commotio cordis(21,22). The events of youth sports or youth athletics are often held in small facilities, ballparks, etc. that are not permanently equipped with AEDs. People and organizations in charge of such events should ensure that an AED is available.

(3) Individuals at high risk of sudden death

For individuals at high risk of sudden death, implantation of an implantable cardioverter-defibrillator (ICD) is the first choice. However, there are many cases where ICD implantation is not performed because of the patient's condition, the patient's, will, or the patient's old age despite the high risk of sudden death. For high-risk individuals, such as young patients with hypertrophic cardiomyopathy, QT prolongation syndrome, or exercise-induced polymorphic ventricular tachycardia, it may be necessary to have an AED at home or at a place like a home for their daily access. However, there should be a condition that someone should be around the individual during certain times to perform basic life support.

6. Importance of education and training in the use of AEDs

Promoting the installation of AEDs will not necessarily result in improvement in the rate of life saving. It is necessary to maintain and manage the AEDs that have been installed and keep them ready for use at any time. In addition, the AEDs should be easily found by facility personnel and residents.

It is also important to increase the number of personnel who can use AEDs through education and training. It has been reported that CPR training increases the awareness of citizens and the rate of CPR(49-53). It is known that the current rate of CPR is insufficient and that there have been cases where AEDs were not used despite their availability(50). To improve the CPR rate, we need to develop CPR training sessions more actively than in the past, deepen the public's understanding of CPR, and increase the number of personnel who can perform CPR using AEDs.

Introductory courses on BLS that can be learned over a short period, focusing on chest compressions and AED operation, should be actively utilized to increase the number of people who can carry out chest compressions and AED operations in the event of cardiac arrests. This creates a society in which people can use the recently increased number of AEDs effectively.

In education and training, it will be effective and efficient to divide educational targets into those involved in AED facilities and the rest of the public.

(1) Education and training of personnel at AED facilities

Personnel at AED facilities should know the location of the nearest AEDs from any place in the facility and should receive training on CPR, including AEDs, regularly. In addition, it is advisable to conduct training on how to respond to a person in a certain area of the facility in the event of a sudden cardiac arrest. It is important to not only conduct general lectures in the classroom but also to carry out simulation training for cases of cardiac arrest at various locations in the facility in order to learn whom to call, how to call 119, and how

to transport an AED.

(2) Education and training for the public

Both the personnel at AED facilities and members of the public are potentially involved in the event of a cardiac arrest. Therefore, as many people as possible need to learn CPR, including the use of AEDs. Until now, lack of manpower and the high cost of promoting the education have been some of the barriers to the spread of CPR(54). However, in recent years, the importance of qualified chest compressions and early defibrillation by electroshock using an AED has been widely recognized, and the effect of compression-only CPR using AEDs has been clearly demonstrated(55). By simplifying the resuscitation procedures, compression-only CPR training has been shown to enable the public to learn CPR in a short period of education and the use of AEDs(56,57). It has also been clearly demonstrated that chest compression-only CPR and early defibrillation using an AED are effective in situations of real events where an AED is available(58). Further education and dissemination of cardiopulmonary resuscitation is required so that all Japanese people can at least practice chest compressions and the use of AEDs.

Focusing on how to carry out chest compressions and how to use AEDs in a short training course would enable us to build a society in which people can use AEDs easily and where the number of AEDs installed is increased(12).

It has been reported that learning how to use an AED in a short period through a video or other means can help people learn how to use it accurately(56). In fact, it has been reported that people can use an AED without attending a training course(59-63). It has also been reported that even untrained rescuers can learn how to use an AED in emergencies. Therefore, the use of AEDs by untrained users should not be restricted. However, it is advisable that life-saving training with the use of AEDs should be provided to ensure high-quality life-saving management. For this purpose, it is important to conduct not only classroom training but also in-facility life-saving training. It is also useful to simulate cases of cardiac arrest in various locations in the facility and to know whom to call, how to call 119, and how to transport an AED.

(3) Further use of AEDs through mutual aid

In recent years, it has been proposed that a system that utilizes a social network system via mobile phones and other devices, which has become increasingly common in people's daily lives, is used not only to deploy AEDs but also to register members of the public who can respond to emergencies and deliver AEDs when needed in the hope of saving lives(64-66). In densely populated areas, such as the urban areas in Japan, a considerable number of people have been reported to have a history of cardiac arrest, and the deployment of AEDs at convenience stores (Conveni) and police stations (Koban) can be useful in the event of a sudden cardiac arrest at residents' homes(34).

7. Notes on the functions of installed AEDs

Since the use of AEDs by non-medical personnel was allowed in Japan in 2004, there have been several improvements in the capabilities of AEDs. The AED function for preschool children is one such example, in which an increasing number of AEDs are now equipped with specific pads or specific keys for preschool children. However, the actual use of AEDs should be more urgent than checking to see if the injured person is a preschool child. If only adult equipment is available at the scene, users should not hesitate to use the early electroshocks

on preschool children(12).

Regardless of the model, AEDs should be easy to operate and, when switched on, an audio guide will instruct the user on how to operate the device. In some cases, voice guidance in a single language is not sufficient to complete an electroshock in the real world. Along with the variability of language in recent years, there is a need for a multi-language voice guide. Visual prompt guidance of AED in the case of real use is also helpful(67). This is important for potential AED users with disabilities and foreigners.

The AED available in our country can automatically analyze the electrocardiogram of the injured person and instruct the rescuer, whether he or she switches on an electroshock button. Using these AEDs, the operator can ensure the safety of his or her surroundings before pressing the electroshock button. It should be noted that in recent years, devices that automatically provide electroshocks have become common in the United States and Europe(67).

8. Conclusion

In Japan, a large number of AEDs have been installed in public spaces across the country, and the widespread use of AEDs has resulted in better resuscitation outcomes compared to past years. However, increasing the number of AEDs installed is not necessarily sufficient to improve the lifesaving rate. The strategic deployment of AEDs, considering the efficiency and management of AEDs, education, and training on using them efficiently, is increasingly becoming necessary. We hope that the guidelines will serve as a reference for local governments and private facilities that are considering introducing AEDs, or have already installed them to save as many lives as possible.

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This revised version is an update of the first version based on the accumulation of knowledge and changes in circumstances during the period from the publication of the first version of the guidelines.

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