

# Utilization of automated external defibrillators installed in commonly used areas of Japanese hospitals

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## ABSTRACT

**Objective.** Since July 2004, it has become legal in Japan for laypersons to use automated external defibrillators (AEDs). We investigated the effect of AED installation in commonly used areas of Japanese Association for Acute Medicine accredited training (JAAM) hospitals.

**Methods.** In 2008, we sent questionnaires to 419 JAAM hospitals enquiring about the systems, operations, outcome and characteristics of AED usage.

**Results.** Valid responses were received from 271 hospitals (64.7%). A total of 251 (92.8%) hospitals installed AEDs, mostly in the outpatient departments. These AEDs could also be used by laypersons. Operational responsibility was mostly assumed by the medical emergency center staff. The Engineering Department was in charge of AED maintenance. Of the surveyed hospitals, 65.5% reported having guidelines for usage. The percentages of hospitals which kept records of AED use and outcomes were low. A total of 66.2% reported having a rapid response team and 98.1% provided a non-standardized resuscitation education program. In 68.3% of hospitals, an AED had been used. AEDs were used not only by medical doctors but also by other health professionals. Among the patients who received AED defibrillation, 42.5% survived without neurological deficit.

**Conclusion.** The utilization of AEDs, installed in commonly used areas of JAAM hospitals, has shown beneficial and effective outcomes for improving the resuscitation and survival of patients who experience in-hospital cardiac arrest. AEDs can be used not only by doctors but also by laypersons, making them more accessible and useful. The strategic installation of AEDs can make hospitals safer.

**Key words:** automated external defibrillators, commonly used areas, in-hospital

## Introduction

The use of manual defibrillators in hospitals in Japan is restricted to medical doctors. Since July 2004, it became legal for lay persons to use an automated external defibrillator (AED). The

number of AEDs installed in public areas (public access defibrillators [PAD]), including medical and nursing facilities has increased recently, and it has been reported that the use of PADs has significantly improved life-saving rates. Japan was the first country to confirm the effectiveness of a nationwide PAD system. (1) In Japan, AEDs are installed in commonly used

areas in hospitals, for example, elevator halls, entrance halls and waiting areas. In hospitals, manual defibrillators are used only by medical doctors. On the other hand, these AEDs can be used not only by hospital personnel but also by outpatients and their family members. However, even with the reported widespread success rates of AEDs, (1) systematic research on how AEDs

installed in commonly used areas of hospitals are managed and used has been scarce.

In this study, we investigated the utilization of AEDs in commonly used areas of Japanese Association for Acute Medicine (JAAM) - accredited training hospitals, which include most representative teaching hospitals in Japan. JAAM, founded in 1973, is the first medical association for emergency medicine in Japan. JAAM membership now exceeds 10,000. In the 1980s, JAAM organized a specialty board. In 2010, JAAM had 3,035 board-certified emergency physicians. (2)

## Methods

In 2008, questionnaires were sent to 419 JAAM-accredited training hospitals - 4 years after AEDs were authorized for general use. The survey consisted of questions covering systems and operations, including the date on which an AED was installed, and the identification of operators. In the questionnaire, we also asked if the institution had guidelines for the use of AEDs, a record of use, whether the outcomes of the use of an AED were recorded, whether the institution had a rapid response team, and whether instructions for resuscitation were provided. The succeeding questions focused on the outcomes and characteristics of AED use.

Data analysis was performed using JMP software (Version 9.0.1; SAS Institute, Cary, NC, USA) and included calculating descriptive indicators of AED use in hospitals. Furthermore, the trends of AED use by operating years and the number of hospital beds were compared using the Cochran Armitage test for trend. Furthermore, respondents were assigned into 4 different survey groups based on the number of installed AEDs, existence of guidelines for AEDs, existence of a system for recording their use as well as the outcomes of their use. Associated unadjusted odds ratios (OR) and confidence intervals (CI) were calculated.

## Results

We analyzed the valid responses obtain-

ed from 271 training hospitals (64.7%). A total of 251 (92.8%) hospitals installed AEDs. In 83.9% of the surveyed hospitals, not only hospital personnel but also laypersons could use installed AEDs. Operational responsibility was assumed by the medical emergency center staff (18.8%) and safety management officers (15.2%). The Engineering Department was in charge of the maintenance of AEDs (57.5%). A total of 65.5% of the surveyed hospitals reported having guidelines, whereas the percentage of surveyed hospitals with records of AED use and records of outcomes of use was low (35.6% and 32.5%, respectively). A total of 66.2% of surveyed hospitals reported having a rapid response team and 98.1% provided a non-standardized resuscitation education program covering various topics. In 68.3% of surveyed hospitals, an AED had been used. Operators were mainly healthcare professionals, the majority of whom were medical doctors (44.3%). Of the patients who received defibrillation with an AED in the 271 training hospitals, 42.5% of patients were resuscitated relatively quickly and survived without any neurological deficit.

We found that the frequency of AED use increased if a hospital had a large number of installed AEDs and had systems for recording its use and outcomes. We also found that if a hospital had a small number of beds and few weekday patients, then that institution had significantly less frequent use of AEDs.

Based on the assignments of respondents into 4 different survey groups, the following results were obtained: (a) those who work in a hospital with 1 to 5 installed AEDs (unadjusted OR, 8.57; 95% CI, 4.56-16.10), (b) those who work in a hospital which has no guidelines for using AEDs (unadjusted OR, 1.71; 95% CI, 0.98-3.00), (c) those who work in a hospital which has no system of recording the use of AEDs (unadjusted OR, 11.38; 95% CI, 4.68-27.67), and (d) those who work in a hospital with a system to record AED use outcomes (unadjusted OR, 5.84; 95% CI, 2.51-13.59) (table 1). When the trend of installation and the use of

AED according to year were examined, significant increases in the number of AEDs installed and the frequency of AED use were observed from 2002-2005 ( $p < 0.0001$ ). Also, a significant increase in the frequency of AED use was observed ( $p = 0.0017$ ) with an increase in the number of hospital beds from  $< 450$  beds to  $> 650$  beds (table 2). However, the frequency of AED use according to year did not significantly differ among the hospitals surveyed.

## Discussion

We set out to investigate the systems, operations, outcomes and characteristics of AED utilization, installed in commonly used areas of hospitals in Japan to clarify their overall impact on making hospitals safer. Since the use of manual defibrillators in Japan is restricted to medical doctors, AEDs have been installed in many facilities, particularly those specializing in acute care medicine (e.g., critical care units or operating rooms). Our survey showed that AEDs, installed in commonly used areas of hospitals, can be used by hospital personnel (mostly nurses and other medical professionals) besides medical doctors, as well as by laypersons. Furthermore, since their operation involves the participation and cooperation of several departments, this system may facilitate interactions among different departments and help promote team-based care. Although it has been reported that the life-saving rate has decreased with the use of AEDs in the United States and other countries, it is difficult to compare the results of such studies with those in Japan, as the surrounding environments are very different. (3) In this survey, we have shown that patients in more than 40% of institutions who were treated with an AED were able to return to normal life relatively quickly. Apart from doctors (who formed the majority), many nurses used AED. (4) Because nurses are the first to notice deterioration in a patient's condition, it is possible to shorten the length of time that patients are exposed to the effects of cardiac diseases, such as cardiopulmonary

**Table 1. Unadjusted odds ratios (ORs) and 95% confidence intervals (95% CI) according to the four categories of automated external defibrillators (AED) use obtained using the logistic regression model.**

Survey group		Total	Use of AED		Unadjusted		
			N	%	OR	95% CI	
Installed AEDs	total	228	155	0,68			
	1-5	84	33	0,39	1,00		
	6-	144	122	0,85	8,57	4,56	16,10
Guidelines for using AEDs	Total	241	164	0,68			
	No	83	50	0,60	1,00		
	Yes	158	114	0,72	1,71	0,98	3,00
System of recording the use of AEDs	Total	240	164	0,68			
	No	153	83	0,54	1,00		
	Yes	87	81	0,93	11,38	4,68	27,67
System of recording AED use outcomes	Total	227	162	0,71			
	No	153	95	0,62	1,00		
	Yes	74	67	0,91	5,84	2,51	13,59

\*A total of 251 hospitals installed AEDs.

**Table 2. Trend of installation and use of automated external defibrillators (AED) according to year and number of hospital beds.**

Survey group		Total installations	Use of AED		P-value*
			N	%	
Year of AED operation	Total	228	164	0,72	p < 0.0001
	2002	13	11	0,85	
	2003	33	32	0,97	
	2004	53	44	0,83	
	2005	62	46	0,74	
	2006	49	26	0,53	
	2007	18	5	0,28	
Number of hospital beds	Total	259	177	0,68	p = 0.0017
	<430	81	43	0,53	
	<650	87	65	0,75	
	>650	91	69	0,76	

\* P-value was determined using the Cochran Armitage test for trend.

arrest (CPA), if the nurses are the AED operators. This way, more patients can be resuscitated and are likely to survive without developing any neurological deficits, within a relatively shorter timeframe than previously reported. (5,6) However, in the current study, we neither obtained nor compared data regarding patient conditions before and after the introduction of AEDs, or their use or non-use or resuscitation rate, nor

did we ascertain the number of patients who were able to survive without developing any neurological deficits within a reasonable timeframe. Nevertheless, the results suggest that the use of AEDs, for resuscitation in hospitals, has a direct effect on a patient's discharge, with no complications of neurological disability. Thus, we consider that the installation of AEDs in commonly used areas of hospitals can be highly

beneficial. Moreover, onsite AED use was associated with higher survival rates than dispatch AED use. AEDs that are installed in commonly used areas may shorten the time to defibrillation since these AEDs can be used even by laypersons. AEDs that are installed in commonly used areas of hospitals are positioned between onsite AED use and dispatch AED use. (7) As mentioned earlier, in hospitals with

more AEDs, records of use, and outcome assessment systems, AEDs are used more often than in hospitals with fewer AEDs. However, merely providing AEDs and establishing such a system does not guarantee an increase in their use. Furthermore, it has been shown that management and instructional systems for AED use are already in place at many medical institutions. Further studies should be conducted to investigate the use of AEDs by encouraging the Plan, Do, Check, Act cycle, which enables the creation of a standardized instructional system, conducting post-treatment investigations based on records of use, and providing feedback to the first respon-

ders and the acute medicine team. In this way, hospital safety may be further improved.

We believe that this preliminary report can provide baseline data for future studies to show that AED installation in commonly used areas of hospitals may effectively increase the number of resuscitated patients who experience in-hospital cardiac arrest.

### Limitations

In this study, we were not able to obtain and compare data regarding patient conditions before and after the use of AEDs, or their use or non-use or patient resuscitation rate. We were also unable to ascertain the number of patients who

returned to normal life within a reasonable timeframe.

### Conclusions

The utilization of AEDs installed in commonly used areas of hospitals may be beneficial and effective for the rapid resuscitation and eventual survival of patients who experience in-hospital cardiac arrest. The establishment of a completely standardized resuscitation system, including a report and verification system after AED usage, and the development of standardized instructions for cardiopulmonary resuscitation in hospitals using AEDs by hospital employees and all hospital users can potentially increase hospital safety.

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