

## Automated External Defibrillator (AED) Use Among Paramedics in the Emergency Department – What are the Obstacles in Using the Automated External Defibrillator in the Pre-Hospital Care Settings?

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### ABSTRAK

*Kajian ini menyelidik faktor yang mempengaruhi penggunaan AED (Defibrilasi automatik luar) ke atas serangan jantung di luar hospital di kalangan paramedik Jabatan Kecemasan Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM). Ini adalah kajian prospektif rentas yang dijalankan dari bulan Disember 2013 hingga Januari 2014. Paramedik dari Jabatan Kecemasan PPUKM didaftarkan dan dinilai dengan menggunakan soal selidik sendiri yang terdiri daripada pelbagai bahagian termasuk penilaian pengetahuan, latihan dan kemahiran. Lima puluh tiga responden telah mengambil bahagian. Enam puluh dua peratus responden pernah menggunakan AEDs di luar hospital. Hanya 83% responden mengakui bahawa mereka bersedia untuk menggunakannya jika perlu. Satu korelasi positif dilihat antara umur dan pengalaman kerja dengan pengetahuan mengenai AED ( $p=0.001$  dan  $p=0.005$  masing-masing). Graduan institusi kerajaan mempunyai pengetahuan yang lebih baik dan tahap keyakinan lebih tinggi daripada graduan institusi swasta ( $p<0.001$ ). Korelasi yang signifikan juga dilihat antara pengalaman kerja dan tahap keyakinan dalam membuat keputusan untuk menggunakan AED ( $p=0.006$ ), penggunaan AED ( $p=0.019$ ) dan penyelesaian masalah komplikasi yang timbul daripada penggunaan AED ( $p=0.002$ ). Faktor utama mengurangkan tahap keyakinan penggunaan AED adalah latihan yang terbatas (3.6%) yang menyebabkan pengurangan keyakinan untuk memulakan penggunaan (45.3%). 88.6% bersetuju bahawa latihan adalah penting sebelum sebarang penggunaan AED. Empat puluh satu peratus daripada responden menyatakan bahawa orang awam Malaysia tidak bersedia menggunakan AED. Kesimpulannya penggunaan dan pengetahuan dalam penggunaan AED di kalangan paramedik masih rendah dan perlu latihan yang lebih intensif.*

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*Kata kunci: defibrilasi automatik luar, paramedik, serangan jantung, di luar hospital, Malaysia*

## ABSTRACT

This study determined factors that influence usage of automated external defibrillation (AED) on out-of-hospital cardiac arrest among paramedics in Emergency Department of Universiti Kebangsaan Malaysia Medical Centre (UKMMC). It was a cross sectional prospective study conducted between December 2013 and January 2014. Paramedics from Emergency Department were enrolled and assessed using the self-filled questionnaire consisting of multiple sections including knowledge assessment, training and practice. In total, 53 paramedics participated in this study. Only 62% participants used AEDs previously. Not more than 83% participants admitted that they would use it if required. A positive correlation was observed between age and work experience with knowledge on AED usage ( $p=0.001$  and  $p=0.005$ , respectively). Government's institute graduates possess better knowledge and higher confidence level than private institutions graduates ( $p<0.001$ ). Positive correlation existed between working experience and confidence level in deciding to use ( $p=0.006$ ), application ( $p=0.019$ ) and troubleshooting in regards of AED use ( $p=0.002$ ). The main factor for low confidence level of AED use was lack of training (73.6%) which resulted in reduced confidence to initiate use (45.3%). Eighty eight percent agreed that training is essential before any AED use. Forty one percent felt that Malaysian public is not ready for AEDs use. As a conclusion, AED usage and knowledge among paramedics is still poor and further training is crucial for the improvement of pre-hospital care in Malaysia.

Keywords: automated external defibrillator, cardiac arrest, Malaysia, out-of-hospital, paramedic

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## INTRODUCTION

Emergency response time in Malaysia is lagging behind, (21.1 minutes compared to 7 minutes in United Kingdom and 11 minutes in New York) (Shah et al. 2008). This delayed response is used as an excuse for termination of resuscitation. In view of this, majority of pre-hospital cardiac arrest were responded only with chest compression without defibrillation. This inadequate use of automated

external defibrillator (AED) despite being equipped in most ambulances, leads to poor outcomes.

Despite the progress made in the science of cardiopulmonary resuscitation, there is lack of data in the usage of AED at pre-hospital area in Malaysia. Contributing factors that can dampen usage of AED include late recognition of cardiac arrest and unpreparedness of emergency medical personnel or bystanders involved. Factors of poor usage of AED are still

questionable, whether it is due to late response time or the unpreparedness of the first responder in using such device. This questionnaire based study investigates the preparedness of our paramedics in operating an AED during pre-hospital resuscitation.

### MATERIALS AND METHODS

The general objective of this study was to determine and analyze factors that influence attitude of paramedics in UKMMC by using an automated external defibrillator (AED). Specific objectives include assessment of knowledge among paramedics in terms of ability to recognize shockable and non-shockable rhythm and the proper use of automated external defibrillator. Other specific objectives were to determine the frequency and confidence level in usage of AED. This study also targetted the identification of deficiency in the proper use of AED during out of hospital resuscitation.

### STUDY DESIGN

This was a prospective cross sectional study which was carried out at the Emergency Department, UKMMC. The study was approved by the ethical review board.

### SAMPLE SIZE CALCULATION

Sample size calculation for known population was done as per calculation shown below (Krejcie et al. 1970).

$$s = X^2 NP (1-P) / d^2 (N-1) + X^2 P (1-P)$$

s = required sample size  
 $X^2$  = the table value of chi-square for 1 degree of freedom at the desired confidence level  
 = 3.841  
 N = the population size (70)  
 P = the population proportion (assumed to be 0.30)  
 d = the degree of accuracy expressed as a proportion (0.05)

$$s = X^2 NP (1-P) / d^2 (N-1) + X^2 P (1-P)$$

$$= 3.841 \times 70 \times 0.3 (1-0.3) / 0.0025 (69) + [3.841 \times 0.3 (0.7)]$$

$$= 56.46 / 0.97911$$

$$= 58$$

A total of 53 currently practicing paramedics in the UKMMC Emergency Department were enrolled in the study during 2 months duration (December 2013 – January 2014).

### INCLUSION CRITERIA

All registered paramedics practicing in the Emergency Department of UKMMC.

### EXCLUSION CRITERIA

Paramedics not registered with the Malaysian Medical Council and not currently practicing were not included.

### SUBJECT RECRUITMENT

Sample population was identified and eligible participants were briefed regarding the study. Written consent from participants was obtained through the consent forms distributed prior to the study.

Table 1: Demographic characteristics of the sample population

Gender	n (%)
Male	33 (62.3)
Female	20 (37.7)
Age	
21 – 30 years old	42 (79.2)
31 – 40 years old	11 (20.8)
Year of Graduation	
Before 2000	1 (1.9)
Between 2000 to 2010	40 (75.5)
After 2010	12 (22.6)
Educational Institute	
Private	20 (37.7)
Government	33 (62.3)
Working Experience	
< 2years	13 (24.5)
2 to 5 years	29 (54.7)
5 to 10 years	7 (13.2)
>10 years	4 (7.5)

## STUDY INSTRUMENTS

A developed and validated questionnaire was used to collect data in this study. The questionnaire consisted of 46 questions. It studied the background and work experience of the targeted group; focusing on the knowledge, attitude and practices among these paramedics in the application of AED. The questionnaire was reviewed, approved and validated by an expert panel. Pilot testing of questionnaire was conducted followed by reliability testing prior to questionnaire distribution. Finalized self-filled form questionnaires were distributed to the participating paramedics (Appendix A). Data collected from the study were entered

into SPSS and analyzed.

## RESULTS

The demographic characteristics of the sample population are reported in Table 1. Of 53 participants enrolled in this study, 33 were male. The age ranged between 20-40 years. The majority of participants were within the age of 20-30 years with a fairly short working experience of less than 5 years. Sixty two percent were graduates from government institute and the majority graduated between 2000 and 2010.

## KNOWLEDGE

Assessment of participants' knowledge on AED (Automated External Defibrillator) using 6 basic questions revealed an average score of 62.0% (3.72 over 6) (Table 2 and Table 3).

## TRAINING

Data on the training of AED use revealed that more than 75% participants attended formal AED training. Approximately half attended at least 3 times or more. It was however alarming that 17% (n=9) of participants had never attended any training on AED. Exploring the demographic background of these 9 participants revealed that they are all aged less than 30 years with 55.6% graduated from government institute. Fifty five percent had working experience of 2 to 5 years whereas 44.4% had worked less than 2 years. The average knowledge score of these participants was 50%.

Table 2: Participants' Basic Knowledge on AED

Question No	Questions	Correct Answer n (%)	Incorrect Answer n (%)
1	AED abbreviations	50 (94.3)	3 (5.7)
2	AED can be used by..	27 (50.9)	26 (49.1)
3	CPR commencement with AED	15 (28.3)	38 (71.7)
4	AED usage in which arrhythmia cases	30 (56.6)	23 (43.4)
5	AED is to be used in which clinical findings	37 (69.8)	16 (30.2)
6	Personnel needed to allow AED usage	37 (69.8)	16 (30.2)

Table 3: Knowledge Score According to Demographic Characteristic

Demographic Characteristic	Score				Average Score	
	100% n (%)	50 to 99% n (%)	Less than 50% n (%)	0% n (%)	n/6	%
<b>All Participants</b>	3 (5.7)	27 (50.9)	23 (43.4)	0 (0)	3.72	62.0
<b>Age</b>						
21-30 y.o	0 (0)	20 (47.6)	22 (52.4)	0 (0)	3.45	57.5
31-40 y.o	3 (27.3)	7 (63.7)	1 (9.1)	0 (0)	4.73	78.8
<b>Gender</b>						
Male	3 (9.1)	18 (54.6)	12 (36.3)	0 (0)	3.97	66.2
Female	0 (0)	9 (45)	11 (55)	0 (0)	3.3	55.0
<b>Graduation Year</b>						
Before 2000	0 (0)	0 (0)	1 (100)	0 (0)	3.0	50.0
2000-2010	3 (7.5)	22 (55)	15 (37.5)	0 (0)	3.83	63.8
After 2010	0 (0)	5 (41.7)	7 (58.3)	0 (0)	3.42	57.0
<b>Educational Institute</b>						
Private	0 (0)	5 (25)	15 (75)	0 (0)	3.0	50.0
Government	3 (9.1)	22 (66.7)	8 (24.2)	0 (0)	4.15	69.2
<b>Working Experience</b>						
<2 years	0 (0)	6(46.2)	7 (53.9)	0 (0)	3.38	56.3
2 to 5 years	0 (0)	13 (44.8)	16 (55.2)	0 (0)	3.45	57.5
5 to 10 years	2 (28.6)	5 (71.5)	0 (0)	0 (0)	4.86	81.0
>10 years	1 (25)	3 (75)	0 (0)	0 (0)	4.75	79.2

Table 4: Data on training of AED usage.

Training Data	Yes n (%)	No n (%)
Formal Training in College	41 (77.4)	12 (22.6)
Formal Training in Workplace	44 (83.0)	9 (17.0)
Structured training?	43 (81.1)	10 (18.9)
Regular and consistency?	26 (49.1)	27 (50.9)
Evaluated and assessed?	36 (67.9)	17 (32.1)
Follow up sessions and recertification	29 (54.7)	24 (45.3)
Queries answered by training?	47 (88.7)	6 (11.3)

Eighty one point one percent participants admitted that there was structured training conducted in their current workplace. However, approximately half of them claimed that it was not conducted on a regular basis (Table 4). Most participants attended the training sessions rated it as fair with 83% having attended last training not more than 2 years ago and 15.1% having attended within the last 5 years.

## PRACTICE AND USAGE CONFIDENCE

All participants are aware that their currently practicing Emergency Department's ambulances are equipped with AED devices. However, only 62.3% participants have use AED on site despite 83% participants admitted that they will use it if needed.

In general, the confidence levels among these paramedics in deciding to use and applying AED on patients was good. Fifty three percent paramedics were confident and 35.8% were very confident in deciding to use AED whereas 50.9% were confident and 41.5% were very confident to

apply AED. However 37.7% had less confidence in troubleshooting complications of AED use (Table 5).

When comparing the level of confidence of participants between cohorts, whether it is in deciding to use AED, applying AED or troubleshooting complications arising from AED use, it was found that the confidence level of participants with working experience of more than 5 years was higher. These facts were supported by statistically significant positive correlations ( $p < 0.05$ ) between working experience and confidence level ( $p = 0.006$ ), in applying AED ( $p = 0.019$ ) and in troubleshooting complications ( $p = 0.002$ ).

Statistically significant correlation was seen ( $p < 0.05$ ) between college training and confidence in using AED ( $p = 0.025$ ). However, there was no significant correlation between college training and confidence in applying AED ( $p = 0.173$ ) or troubleshooting ( $p = 0.051$ ). There was significant correlation ( $p < 0.05$ ) between workplace training and confidence in using AED ( $p = 0.015$ ). There was no significant correlation seen between workplace training and troubleshooting

Table 5: Confidence level in using AED

Task	Very Confident n (%)	Confident n (%)	Less Confident n (%)	Not Confident n (%)
Deciding to use AED	19 (35.8)	28 (52.8)	4 (7.5)	2 (3.8)
Applying AED	22 (41.5)	27 (50.9)	2 (3.8)	2 (3.8)
Troubleshooting Complications	10 (18.9)	23 (43.4)	19 (35.8)	1(1.9)

Table 6: Factors affecting practice and confidence level on AED usage

Factors Affecting	Strongly Disagree n (%)	Disagree n (%)	Agree n (%)	Strongly Agree n (%)
Fear of harming patients	24 (45.3)	28 (52.8)	1 (1.9)	0 (0)
Lack of confidence to initiate usage	6 (11.3)	23 (43.4)	23 (43.4)	1 (1.9)
Lack of training	4 (7.5)	10 (18.9)	36 (67.9)	3 (5.7)
Young age of victim	13 (24.5)	28 (52.8)	10 (18.9)	2 (3.8)
Victims background	14 (26.4)	23 (43.4)	15 (28.3)	1 (1.9)
Lack of legal coverage	5 (9.4)	23 (43.4)	22 (41.5)	3 (5.7)
Fear of disease transmission	20 (37.7)	24 (45.3)	8 (15.1)	1 (1.9)
Knowing victim personally	12 (22.6)	28 (52.8)	12 (22.6)	1 (1.9)
Victim’s gender	20 (37.7)	21 (39.6)	12 (22.6)	0 (0)
Need frequent training repetition	3 (5.7)	4 (7.5)	24 (45.3)	22 (41.5)

Table 7: Attitude and perception towards AED usage

Factors Affecting	Strongly Disagree n (%)	Disagree n (%)	Agree n (%)	Strongly Agree n (%)
AED usage on site is risky	17 (32.1)	26 (49.1)	10 (18.9)	0 (0)
AED should not be used by the public	11 (20.8)	20 (37.7)	16 (30.2)	6 (11.3)
Paramedics need MO’s supervision	31 (58.5)	20 (37.7)	2 (3.8)	0 (0)
AED delay patient’s transport	3 (62.3)	20 (37.7)	0 (0)	0 (0)
AED is not easy to apply on site	19 (35.8)	31 (58.5)	3 (5.7)	0 (0)
AED not easy as journey is short	26 (49.1)	26 (49.1)	1 (1.9)	0 (0)
Training is a must before using AED	4 (7.5)	2 (3.8)	27 (50.9)	20 (37.7)
AED usage is not easy to learn	28 (52.8)	22 (41.5)	2 (3.8)	1 (1.9)
Not sure to handle complication arises	8 (15.1)	30 (56.6)	14 (26.4)	1 (1.9)

complications arising from AED use ( $p=0.128$ ).

### **FACTORS AFFECTING CONFIDENCE LEVEL AND AED USE**

Lack of training (73.6%) was the main factor affecting confidence level. 86.8% participants agreed on the need of frequent training (Table 6). 47.2% participants believed there was lack of legal coverage in cases where complication arose from AED use.

### **ATTITUDE AND PERCEPTION**

Around 88.6% participants agreed that training is a pre-requisite of any AED use. Forty one point five percent believe that Malaysian public is not ready for AED use (Table 7). The reason is that even though a person with medical background is not confident in using AED, they postulate that the case is the same with the public.

### **DISCUSSION**

From the questionnaire, it can be concluded that the participants lack adequate AED training. This was due to incorrect answers given by a large percentage of the participants. In addition to this, AED was used in only 40% of out of hospital cardiac arrest that was received by ED UKMMC from July 2013 – November 2013. Majority of the participants had working experience less than 5 years (79.2%). The average score of participants in AED use assessment was 62%. Alarming, approximately half of these

participants gave an incorrect response to 3 vital questions on AED use. Factors such as age, working experience and educational institution contributed positively to participants' knowledge (Table 3). There was a positive correlation between duration of years working and amount of training.

Seventy seven percent participants had attended formal AED training in college and 83% in workplace (Table 4). Nearly half of them had attended more than 2 times. Nevertheless, 17% ( $n=9$ ) participants had never attended any AED training. Hence, there is a need for all paramedics to be well versed in AED use before being posted in the Emergency Department. Approximately 55.6% of the participants had working experience of 2 to 5 years, whereas 44.4% had worked less than 2 years.

In comparison with advanced countries such as Japan, the experience and willingness of a paramedic / Emergency Medical Technician in using AED was unquestionable. Taniguchi et al. (2008) performed a study in Japan on 3328 individuals from various backgrounds. As a result, all EMTs, 86% of nurses, 90% medical students, 15% high school students and 44% of teachers had knowledge regarding usage of AEDs. This also represents nearly the same percentage of those who are willing to use the device. Hence, a benchmark of 100% knowledge and willingness among our EMT in AED usage is necessary prior to promoting it to public.

Laypersons and health care providers were unwilling to use AEDs due to several reasons such as poor



awareness, lack of knowledge and experience. In terms of healthcare providers, confidence to decide, apply and handling complications was more than 80%. Nevertheless 37.7% (n=20) never used AED on site. Eighty three percent of participants would use AED if indicated.

Retention of basic CPR and AED knowledge requires a more systematic training approach (Berdin et al. 1993). Re-education/refresher courses clearly maintain nurses' knowledge and enhancing skills in AED use (Soo-Il et al. 2008). Preusch and colleagues stressed the importance of training even with experienced staff. (Preusch et al. 2010)

Eighty nine percent of participants agreed that training is a must before any AED use. Twenty eight percent of participants were unsure on how to handle complications that arise. This figure is unacceptable since they are the front line in the healthcare delivery system. It can be concluded that training of AED use is still lacking and needs to be refreshed time by time. This is in comparison the use of AED and initiation of CPR depends on the availability of systematic training (Kozamani et al. 2012).

This study can be extended to paramedics working in the district hospitals and health clinics. This is due to the heightened responsibility in handling patients. Concurrently knowledge of AED use can be introduced to Malaysian public by these trained paramedics. Trained paramedics can run courses for public in order to consolidate knowledge among the trained and the trainers.

Kitamura et al. (2010) reported following nationwide placement of public AED's, there was an increase of earlier defibrillation delivery among laypersons. This resulted in an increase of 1 month survival rate among out of hospital arrest. Efforts should be placed in both aspects, in the availability of AED's and the public knowledge of usage, i.e through public courses or mass media.

## LIMITATIONS

The study had a small sample size. The study also lack of scene-based section/real time situation in order to evaluate their knowledge in facing a real situation. The seniors or supervisors paramedics might not be practicing that much as compared to their early days. This is due to their job commitment emphasizing more on the administrative side. Hence, working experience should be related only to when pre-hospital work is involved.

## CONCLUSION

This study provides as an insight to the current knowledge of AED use among paramedics in UKMMC. Emphasis should be put on training of AED use. Knowledge, amount of training received and working experience are factors that influence confidence of AED use. While working experience is something non-modifiable, the other two factors can be improved with adequate training. AED knowledge and practice should be the main core knowledge emphasized in the diploma and degrees of paramedic training.

All first responders should be well-equipped with knowledge and skills in handling AED prior to introducing public training.

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