A STUDY ON THE EFFECTIVENESS OF EMERGENCY ROTATION TO IMPROVE CARDIOPULMONARY RESUSCITATION SKILL AMONG HOUSE OFFICER

BY

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AKUJANJI

Diperakui bahawa disertasi yang bertajuk **"A STUDY ON THE EFFECTIVENESS OF EMERGENCY ROTATION TO IMPROVE CARDIOPULMONARY RESUSCITATION SKILL AMONG HOUSE OFFICER"** merupakan kerja dan penyelidikan yang asli daripada **DR SHAHIRA BT MD ISMAIL**, No Kad Pengenalan: **841008075266**, No. Matrik: **PUM 0179/14** dari tempoh 2014 hingga 2018 adalah di bawah penyeliaan saya. Disertasi ini merupakan sebahagian daripada syarat untuk penganugerahan **Sarjana Perubatan (Perubatan Kecemasan)**. Segala hasil penyelidikan dan data yang diperolehi adalah hak milik terpelihara Universiti Sains Malaysia

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ABSTRAK

Pengenalan:

Kajian ini bertujuan untuk menunjukkan keberkesanan jabatan kecemasan dalam meningkatkan tahap kemahiran Pegawai Latihan Siswazah (PLS) dalam kardiopulmonari resusitasi (CPR) dan penggunaan mesin Automated External Defibillator (AED). Selain itu, kajian ini juga ingin menentukan faktor-faktor yang membantu meningkatkan kemahiran pegawai perubatan dalam CPR dan penggunaan mesin Automated External Defibrillator (AED)**.**

Metodologi:

Kajian ini adalah kajian pemerhatian prospektif dari Jun 2016 sehingga May 2017 di Jabatan kecemasan Hospital Universiti Sains Malaysia (HUSM) dan Jabatan kecemasan Hospital Pulau Pinang (HPP) melibatkan enam puluh lima orang PLS. Penilaian kemahiran CPR dan penggunaan mesin AED dilakukan pada minggu pertama mereka menyertai penempatan berkala di Jabatan Kecemasan dan selepas empat belas minggu menjalani latihan di Jabatan Kecemasan. Terdapat empat belas kemahiran yang dinilai di HUSM dan tiga belas kemahiran dinilai di HPP. Dua orang pegawai penilai terlibat dalam setiap sesi penilaian PLS. Markah min dari dua penilai akan dikira sebagai markah akhir. Manikin Laerdal Little Anne dan mesin AED latihan digunakan dalam kajian ini.

Keputusan:

Terdapat perbezaan yang signifikan antara skor untuk kemahiran resusitasi kardiopulmonari sebelum dan selepas menyelesaikan penempatan berkala di jabatan kecemasan HPP dengan min skor meningkat dari 9.15±2.75 kepada 11.45±1.45 (nilai p <0.001). Kajian juga menunjukkan peningkatan pada PLS di HUSM. Markah min kemahiran meningkat dari 8.37±2.92 kepada 12.97±1.22 dengan nilai p <0.001.Terdapat hubungan yang signifikan antara pengunaan mesin AED oleh PLS di HUSM dengan kemahiran resusitasi kardiopulmonari selepas penempatan berkala di jabatan kecemasan (p = 0.040).

Kesimpulan:

Kajian ini menunjukkan penempatan di jabatan kecemasan selama empat belas minggu dapat meningkatkan kemahiran pegawai perubatan siswazah dalam CPR dan penggunaan mesin AED. Selain itu, ia juga menunjukkan PLS yg mengendalikan mesin AED di jabatan kecemasan mempunyai prestasi yg lebih bagus dalam kemahiran CPR selepas penempatan berkala di jabatan kecemasan.

ABSTRACT

Introduction

This study aimed to assess the effectiveness of emergency posting during housemanship in improving the skills of cardiopulmonary resuscitation (CPR) and in handling automated external defibrillator (AED) among house officers (HOs). It also aimed to identify the associated factors that improve the CPR skills and AED handling.

Materials and Methods

A prospective observational study was conducted in Emergency department (ED) Hospital University Sains Malaysia (HUSM) and ED Hospital Pulau Pinang (HPP) from June 2016 until May 2017 involving sixty five HOs. The HOs were assessed on CPR and AED handling in the first week of emergency posting and fourteen weeks after. Their assessment was based on the American Heart Association (AHA) Basic Life Support (BLS) for healthcare Providers Course Final Evaluation Skills with the maximum scores of fourteen for HUSM for and thirteen for HPP. Two assessors were involved in each session. The mean score from both assessors was chosen as final mark. Laerdal Little Anne Manikin and Laerdal AED was used during this study.

Results

There were significant mean differences for CPR skills before and after completing emergency posting in ED HPP, which the mean score increases from 9.15±2.75 to 11.45±1.45 with the p-value of <0.001. The study also showed similar statistical significant for the cohort in ED HUSM. The mean score increases from 8.37±2.92 to 12.97±1.22 with the p-value of <0.001.This study demonstrated that multiple real life hands on AED during emergency posting were significant in contributing to improvement of CPR skills in HUSM with the p-value of 0.04.

Conclusions

This study concluded that attending a period of fourteen weeks in emergency posting had significantly improved the CPR skills among HOs. Furthermore it also showed that HO with multiple real life AED handling during emergency posting had better performance in CPR skills.

Keywords:

Cardiopulmonary resuscitation skill, emergency department, house officer, Malaysia

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

The importance of cardiopulmonary resuscitation skill is well established. When a cardiac arrest occurs the prognosis is poor unless effective resuscitation measures are initiated immediately (Vincent-Lambert *et al.,* 2016). The immediate initiation of cardiac compression can double or quadruple the chances of survival after cardiac arrest (Nolan *et al.*, 2015). There is a lot of data available indicating that high quality CPR improves survival from cardiac arrest. The components of high quality CPR include chest compression at adequate rate (100-120/min), adequate depth of cardiac compression (2 inches or 5 cm for average adult and avoid excessive compression), allowing chest recoil in between compression, minimize interruption during chest compression and avoid excessive ventilation (Neumar *et al.*, 2015). CPR provides small but sufficient amount of blood flow to the brain and heart. It also prolongs the time of VF and increases the likelihood that a shock will terminate VF and allows the heart to resume effective rhythm and systemic perfusion (Yannopoulos *et al.*, 2015).

Defibrillation within 3 – 5 minutes of collapse can produce survival rates up to 50% - 75% (Nolan *et al.*, 2015). Defibrillation does not "restart" the heart but it actually briefly stop cardiac electrical activity. If the heart is still viable, its normal pacemaker may then resume firing and produce effective ECG rhythms that may ultimately produce adequate blood flow (Yannopoulos *et al.*, 2015).

As doctors in emergency department, the knowledge and skills of cardiopulmonary resuscitation is vital as we are usually the first persons to attend to the patient in emergency situation. In Malaysia, fresh medical graduate will undergo a period of supervised training in 6 major postings. According to the Malaysian Medical Act 1971, 'internship' is a period of structured supervised practical training after graduation. Section 13(2) of the Medical Act 1971 dictates that fresh medical graduates shall undergo further training for the purpose of obtaining experience as a house officer which includes 4 month postings in Surgery, Orthopaedics, Medicine, Paediatrics, Obstetrics & gynaecology and Accident and Trauma. The aim of internship training is to provide fresh graduates with the appropriate knowledge, skills and experience. Once they complete their housemanship they will be granted full registration as medical officers and will be making decisions and treating patients on their own. Therefore this period of housemanship training is very crucial in order to produce a safe and competent medical officer.

In the midst of enforcing the knowledge of CPR and AED handling among the public, how sure are we that our house officers are able to respond accordingly in a patient with cardiac arrest?

1.2 RATIONALE OF THE STUDIES

A lot of studies on assessing junior doctors' knowledge and skills in cardiopulmonary resuscitation have been published and most of these studies showed unsatisfactory result. For example, a study was conducted to assess knowledge on cardiopulmonary resuscitation among clinician in South Africa and surprisingly none from 100 participant showed adequate knowledge (Botha *et al.*, 2012). A prospective study was undertaken to assess the level of first aid and basic life support (BLS) competence of junior doctors at the Radboud University Nijmegen Medical Centre (RUNMC), the Netherlands and it also concluded that the level of first aid and basic life support of the junior doctors at the RUNMC is low and does not meet the required level as stated in the guidelines for practice in the Netherlands (Tan *et al.*, 2006). Other studies that shows unsatisfactory result was perform by J.H Bell et al (1995). This study assess the basic and advanced cardiopulmonary resuscitation skills of 30 trainee anaesthetists in a simulated exercise and only one participant able to perform basic CPR as outlined by the guideline (Bell *et al.*, 1995).

However, there is not yet a study which was done in Malaysia to specifically access the skills of performing CPR and handling automated external defibrillator (AED) among our house officers (HO). These skills are vital especially among emergency doctors as they are expected to be competent as the front liner.

Emergency medicine rotation is usually fulfilled by the house officers at the end of their housemanship. A minimum of at least 1 year experience is needed before they undergo this rotation. They will gain experience from managing a variety of cases from simple to seriously ill patients. The purpose of this study is to assess whether emergency medicine posting itself is effective in improving HOs CPR skills and the factors that contribute to it.

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CHAPTER 2: OBJECTIVES

OBJECTIVES

2.1 General objectives

To assess the skills of house officer in cardiopulmonary resuscitation

2.2 Specific objectives

2.2.1 To assess the skills of house officer in cardiopulmonary resuscitation before start training in emergency rotation.

2.2.2 To compare the cardiopulmonary resuscitation skills after completion of the emergency rotation.

2.2.3 To determine the relationship of houseman previous exposure and participation in cardiopulmonary resuscitation with cardiopulmonary resuscitation skill

CHAPTER 3: MANUSCRIPT

3.1 TITLE PAGE

THE EFFECTIVENESS OF EMERGENCY ROTATION TO IMPROVE CARDIOPULMONARY RESUSCITATION SKILL AMONG HOUSE OFFICER

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3.2 ABSTRACT

Introduction

This study aimed to assess the effectiveness of emergency posting during housemanship in improving the skills of cardiopulmonary resuscitation (CPR) and in handling automated external defibrillator (AED) among house officers (HOs). It also aimed to identify the associated factors that improve the CPR skills and AED handling.

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Results

The mean score in the first week of emergency medicine (EM) posting for both centres was 8.97±2.79 and the mean score after emergency medicine posting was 11.8±1.51. There were significant mean differences for CPR skills before and after completing emergency posting in ED HPP, which the mean score increases from 9.15±2.75 to 11.45±1.45 with the p-value of <0.001. The study also showed similar statistical significant for the cohort in ED HUSM. The mean score increases from 8.37±2.92 to 12.97±1.22 with the p-value of <0.001.

This study demonstrated that multiple real life hands on AED during emergency posting were significant in contributing to improvement of CPR skills in HUSM with the p-value of 0.04.

Conclusions

This study concluded that attending a period of fourteen weeks in emergency posting had significantly improved the CPR skills among HOs. Furthermore it also showed that HO with multiple real life AED handling during emergency posting had better performance in CPR skills.

Keywords:

Cardiopulmonary resuscitation skill, emergency department, house officer, Malaysia

3.3 INTRODUCTION

The prevalence of heart diseases and cardiac arrests in Malaysia is on the uphill trend (1). The prognosis of cardiac arrest is poor if effective resuscitation is not being initiated immediately. Study has shown that immediate initiation of cardiac compression and high quality CPR can improve the chances of survival after cardiac arrest (2). Meaney, Bobrow et al (2013) demonstrated that through better measurement, training and systems-improvement processes of CPR quality, there is a significant impact on survival from cardiac arrest (3). Good bystander CPR was associated with a shorter arrest-CPR interval and improved hospital discharge (4).

The components of high quality CPR include chest compression at adequate rate (100-120/min), adequate depth of cardiac compression (2 inches or 5 cm for average adult and to avoid excessive compression), allowing full chest recoil in between compression, to minimize interruption during each compression and to avoid excessive ventilation (5). On top of that, defibrillation within three to five minutes of collapse increases survival rates by up to 50% - 75% (2).

As a doctor, the knowledge and skills of CPR are vital as we should ideally be the first person to attend patient in an emergency situation. In Malaysia, fresh medical graduate will undergo a period of supervised training in 6 major postings. With regards to the Medical Act 1971, internship is a period of structured supervised practical training soon to be done after graduation. The aim of internship training is to provide fresh graduates with appropriate knowledge, skills and experience. According to official portal of Malaysian Medical Council (MMC), once a house officer (HO) had completed their housemanship training, they will be granted full registration and are expected to be competent in decision making. Therefore the period of housemanship training is very crucial in order to yield safe medical officers.

There are a lot of studies on assessing knowledge and skills in CPR among junior doctors that have been published and most of these studies displayed unsatisfactory result. For example, a study was conducted to assess knowledge on cardiopulmonary resuscitation among clinician in South Africa and surprisingly none from 100 participants showed adequacy in knowledge (6). A prospective study was undertaken to assess the level of first aid and basic life support (BLS) competence of junior doctors at the Radboud University Nijmegen Medical Centre (RUNMC), Netherlands and it also concluded that the level of first aid and BLS of the junior doctors at the RUNMC is low and it did not meet the required level as stated in the guidelines for practice in the Netherlands (7). Another study that showed unsatisfactory result was performed by J.H Bell et al (1995) where this study assessed the basic and advanced cardiopulmonary resuscitation skills of 30 trainee anaesthetists in a simulated exercise and only one participant is able to perform basic CPR as outlined by the guideline (8).

CPR and AED handling are vital skills that each of the emergency doctors should have as they are expected to be the first liner in handling emergencies. HO usually undergoes his or her emergency posting towards the end of their housemanship. Emergency department operates twenty four hours daily and treats wide spectrum of diseases. Therefore, emergency postings require HOs that are equipped with at least basic clinical skills and knowledge. The purpose of this study is to demonstrate whether emergency posting itself is effective in improving the HO CPR skills and the factors that contributes to it.

3.4 MATERIALS AND METHODS

Design and subject recruitment

This study was a prospective observational study from June 2016 until May 2017 and was done at ED HUSM and ED HPP. There were a total of 65 participants with a breakdown of fifteen subjects from ED HUSM and fifty subjects from ED HPP. All HOs who underwent the emergency posting from June 2016 to June 2017 as their fourth posting and above were included in this study. HO with working experience less than one year or did not complete three posting upon joining emergency posting were excluded.

Instruments

To measure CPR skills during this study, the investigator conducted mock codes in which the HOs were asked to respond to a Laerdal Little Anne Manikin. Their responses were recorded on the Final Evaluation Skills sheet for Adult CPR based on AHA BLS 2001. This checklist was used in previous study (9) to measure the CPR skills. For this study, the checklist was modified according to AHA 2015 update.

HOs were instructed to perform the skill on the manikin after a standard scenario given. The assessors observed the sequence of actions included on the skills checklist. HO received a score of zero on the CPR checklist for any item not performed, performed out of sequence or performed incorrectly. The highest possible score on the skills checklist was fourteen for correct items. Each mock code took approximately five minutes per HO. They were tested in their first week of emergency posting and were reassessed again after completing at least fourteen weeks of emergency posting. Fourteen weeks was chosen as minimal duration of placement in emergency posting in order to ensure adequate exposure time to emergency medicine.

All fourteen items in the checklist were used to assess fifteen HOs in ED HUSM as all of them are trained based on AHA guideline 2015 which emphasized on checking pulse for healthcare provider before starting CPR. Item four, checking pulse were not included in the assessment of HO from ED HPP as they were trained according National Committee on Resuscitation Training (NCORT) which did not recommend checking pulse before starting CPR. Therefore thirteen items were tested for HO from HPP.

There were two assessors for both sessions to avoid bias. Both assessors are Advanced Cardiac Life Support (ACLS) 2015 provider with regular two monthly assessment to allow for standardisation. A study (10) conducted showed significant decline in BLS and ACLS skill post training 3 months. Demographic and clinical data such as age, gender and race were obtained. Important details such as whether the HO had attended any ACLS or BLS course within one year, exposure to more than five times to CPR and AED handling during emergency posting were included in the proforma.

Statistical analysis

The study was approved by the Human Research Ethics Committee USM (USM/JEPeM/15120576) and by Malaysian Ethics and Research Committee (NMRR-16-514-30273(IIR)). All data were managed and analyzed by IBM SPSS Statistics for Windows, Version 22.0. Descriptive statistics were expressed as frequency and percentage for categorical variables and mean and standard deviation for numerical variables. Independent categorical variables were compared using chi-square test. Statistical significance was calculated using independent t-test between groups and paired t-test within groups for continuous variables. A p value < 0.05 with a 95% confidence interval is considered as statistically significant for all statistical analysis in this study. Simple linear regression was used to determine the relationship of previous exposure to ACLS, BLS and exposure to more than five times to CPR and AED handling with the level of skill after emergency posting.

3.5 RESULTS

Total HO included in this study was sixty five person. The total score for the complete skill testing was fourteen for ED HUSM and thirteen for ED HPP. There were fifty and fifteen HOs involved in HPP and HUSM, respectively. With regard to CPR skill, the mean score in the first week of emergency medicine (EM) posting for both centres is 8.97±2.79 and the mean score after emergency medicine posting is 11.8±1.51.

Table 1 showed that there were significant mean differences for CPR scores before and after completing emergency posting in HPP, in which the mean score increased from 9.15±2.75 to 11.45±1.45 with the p-value of <0.001. The study also showed similar statistical significant of those who were from in HUSM. The mean score increased from 8.37±2.92 to 12.97±1.22 with the p-value of <0.001.Table 2 showed the factors that might have influence in improving CPR skills. The factors that were measured are involvement in ACLS or BLS within 1 year before entering emergency posting and participation in real life CPR or AED handling during emergency posting.

This study demonstrated that multiple hands on participation in AED handling during emergency posting resulted in a significant improvement of CPR skills in HUSM with the p-value of 0.04. Despite being trained with BLS, ACLS and having CPR exposure, the result showed that it did not contributed into the improvement of the CPR skills (Table 2).

Table 3 showed descriptive results of number of houseman who managed to perform each steps correctly according to the proforma in the form of percentage. The skill that showed highest improvement was head-tilt-chin-lift which improved from 49.2% to 89%. This was followed by breathing assessment which showed increment from 44.6% to 83.1% and AED usage increment from 60.0% to 93.8%.

Table 1: Comparison of cardiopulmonary resuscitation skills after complete the emergency rotation.

Skill score by centre	Pre Mean (SD)	Post Mean(SD)	Mean difference (95%CI)	t statistics (df)	*p* value
HPP	9.15(2.75)	11.45(1.42)	-2.3(-2.96,-1.64)	-6.99(49)	<0.001
HUSM	8.37(2.92)	12.97(1.22)	-4.6(-6.05,-3.15)	-6.82(14)	<0.001

Table 2: Relationship Between Different Factors and CPR skills

Centre	Variables	Regression coefficient (95%CI)	Value p-value
HPP	BLS course		
	In ED	0	
	Within 1 year	-0.48(-2.19,11.90)	0.577
	AED in ED		
	No	0	
	Yes	0.63(-0.19,1.45)	0.128
	ACLS within 1 year		
	No	0	
	Yes	0.20(-0.63,1.02)	0.636
	CPR more than 5 in ED		
	No	0	
	Yes	0.68(-0.36,1.73)	0.194
HUSM	BLS course		
	In ED	0	
	Within 1 year	1.19(-0.75, 3.14)	0.208
	AED in ED		
	No	0	
	Yes	0.38(0.04,1.55)	0.040
	ACLS within 1 year		
	No	0	
	Yes	1.00(-0.27,1.29)	0.111

Table 3: Skill tested for cardiopulmonary resuscitation skill before and after

Emergency rotation

Skill step	Critical performance criteria	Percentage of participant who did it correctly (n=number of houseman)		Percentage difference (%)
		Before n (%)	After n (%)	
1.	Avoid Danger - Make sure scene is safe	39 (60.0)	50 (76.9)	16.9
2.	Check for response - No breathing/normal breathing/only gasping - At least 5 seconds but not more than 10 seconds	59 (90.8)	63 (96.9)	6.9
3.	Activate emergency response system/call for help - Nurse, please bring the AED machine	37 (56.9)	53 (81.5)	24.6
4.	Correct hand placement - Lower half of sternum	63 (96.9)	64 (98.5)	1.6
5.	Adequate rate 100-120/min	57 (87.7)	64 (98.5)	10.8
6.	Adequate depth (5-6cm)	48 (73.8)	60 (92.3)	18.5
7.	Allow complete chest recoil - Do not lean on the chest after each compression	59 (90.8)	65 (100.0)	9.2
8.	Minimize interruption (interrupt less than 10 sec)	57 (87.7)	65 (100.0)	12.3
9.	Airway - Head tilt chin lift	32 (49.2)	58 (89.2)	40.0
10.	Breathing - Ventilation ratio 30:2 - Adequate chest rise	29 (44.6)	54 (83.1)	38.5
11.	AED usage - Switch on - Attach pads on patient chest - Analyse rhythm (Stop CPR) - Clear victims and deliver shock	39 (60.0)	61 (93.8)	33.8
12.	Continue CPR immediately	36 (55.4)	54 (83.1)	27.7
13.	Check pulse and rhythm after 2 minutes	31 (47.7)	49 (75.4)	27.7

3.6 DISCUSSION

Based on this study, the mean score of CPR skills among the HOs prior to starting emergency rotation for both HPP and HUSM was 8.97±2.79. The scores did not differ much from individual mean score of 9.15±2.75 and 8.37±2.92 for both ED HPP and ED HUSM, respectively. The two centres had different training background. Hence, from fourteen items that were used in ED HUSM, it was cut down to thirteen in ED HPP after the removal of one component which was pulse check.

In HUSM, the resuscitation training was based on AHA 2015 guideline where they advocate pulse check prior to starting CPR among the healthcare providers (11, 12) (Class IIa LOE C) but not among the lay rescuer. On the other hand, resuscitation training in HPP is based on National Committee on Resuscitation Training (NCORT) 2010 of which The International Liaison Committee on Resuscitation (ILCOR) stated that palpation of the pulse as an indicator of presence or absence of cardiac arrest is unreliable (13). Despite this differences, the outcome of CPR skills among the HOs remained the same.

The mean score difference for both centres showed significant improvement for pre- and post-assessment among the HOs from 9.15±2.75 to 11.45±1.42 in HPP and 8.37±2.92 to 12.97±1.22 in HUSM. Among a few reasons that HOs showed improvement in their CPR skills were postulated by the weekly Continuous Medical Education (CME) in both centres. In HUSM there were specific CME for HO on AED, BLS and ACLS. Other than that, resuscitation skills were applied during their daily work shift especially when performing bedside CPR in resuscitation areas. This is supported by experiential learning focuses on the learning process for the individual through observation and interaction as opposed to reading or didactic learning. Thus, HO made discoveries and experiments with knowledge firsthand, hence a better learning outcome (14). This is supported by the concept of see one, do one, teach one (15). Brief bedside CPR in ED also shown to improve CPR skills retention (16).

Another objective was to determine the factors that is associated with the improvement of CPR skills among HOs. This study found out that AED usage in emergency posting had shown significant outcome in HUSM with the p value of 0.04 as compared to HPP. It is postulated that HOs in HUSM had more exposure to AED usage in which they have to attend a short BLS course and was encouraged to accompany pre-hospital ambulance call once they entered the department. It is widely known that AED is more commonly used in Pre Hospital Care settings as compared to intra-hospital in which defibrillator is more of a preferred choice (17). Handling AED for defibrillation is crucial part of resuscitation that significantly improve the outcome in cardiac arrest patient (18).

This study had proven that skills that showed tremendous progress were head-tilt-chin-lift, breathing technique and AED usage with the percentage of improvement of 40.0%, 38.5% and 33.8%, respectively. This also concluded that most of the HOs knew how to perform correct hand placement during CPR with only a minimal difference of 1.6%. In conclusion, all the skills that were tested showed improvement after completion of emergency posting.

In this study, it was displayed that there were no significant improvement of CPR skills among the HO whether it is with or without life support courses namely BLS and/or ACLS. This is also demonstrated by a study by Smith et al in which it was proven that BLS and ACLS skills started to decline after three months (10). HO should be formally assessed using a manikin with a feedback mechanism or an expert instructor to ensure CPR skills are adequate at least once in six month (19). Remedial training must be provided as often as required to ensure the adequacy of the skills. Resuscitation training equipment should be made available at emergency department to allow self-study and practice to prevent deterioration between updates (20).