

KNOWLEDGE AND ATTITUDE TOWARDS CARDIOPULMONARY RESUSCITATION AND DEFIBRILLATION AMONG GENERAL PRACTITIONERS IN MELAKA, MALAYSIA

Atan NA¹, Fauzi MH^{2,3}, Yaacob N^{2,3}, Md Noh AY^{2,3}, and Che Hamzah MSS^{2,3}.

¹Department of Emergency and Trauma, Hospital Melaka, Jalan Mufti Haji Khalil, 75400 Melaka, Malaysia

²Department of Emergency Medicine, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, 16150 Kubang Kerian, Kelantan, Malaysia

³Hospital Universiti Sains Malaysia, Health Campus, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia

Correspondence:

Mohd Hashairi Fauzi,

Department of Emergency Medicine,

School of Medical Sciences,

Universiti Sains Malaysia, Health Campus,

16150 Kubang Kerian, Kelantan, Malaysia

Email: hashairi@usm.my

Abstract

The study focuses on assessing the knowledge of and attitude towards cardiopulmonary resuscitation (CPR) and defibrillation among general practitioners in Melaka. The aim is to understand the factors associated with their level of knowledge and attitude, as well as their preference for conventional CPR over chest compression-only resuscitation. The study utilised a cross-sectional design and employed a validated questionnaire for data collection. Convenience sampling was used to recruit general practitioners in Melaka, resulting in a total of 117 respondents. Among them, 77.8% had received training in Basic Life Support (BLS), while 58.1% had undergone Advanced Cardiac Life Support (ACLS) training. Interestingly, 84% of the respondents claimed to know how to handle an Automatic External Defibrillator (AED), but only 23.9% actually had an AED in their clinic. The study findings indicate that those who were trained in BLS and had more than 10 years' experience exhibited better knowledge regarding CPR and defibrillation. The statistical analysis confirmed a significant association between BLS training ($P = 0.019$) and years of experience ($P = 0.006$) and level of knowledge. In conclusion, the majority of general practitioners in Melaka demonstrated a good knowledge of CPR and expressed a positive outlook on defibrillation. The findings suggest that BLS training and longer professional experience are associated with higher levels of knowledge in CPR and defibrillation.

Keywords: Knowledge, Attitude, CPR, Defibrillation, General Practitioner

Introduction

Out-of-hospital cardiac arrest (OHCA) is a global health issue that leads to significant mortality and morbidity. Unfortunately, the outcomes for patients who experience OHCA have historically been poor (1). According to data from The Resuscitation Outcome Consortium Cardiac Registry, the incidence of OHCA in 2016 exceeded 350,000 cases, with bystander cardiopulmonary resuscitation (CPR) being performed in approximately 46.1% of cases, while the survival rate was only 12% (2).

Studies have highlighted the importance of early CPR, the initial rhythm of ventricular fibrillation, and the use of automatic external defibrillators (AEDs) in improving short-term survival rates following OHCA. Systematic reviews have shown that more than 70% of OHCA cases involve shockable rhythms, such as ventricular fibrillation

or pulseless ventricular tachycardia (3, 4). In the United Kingdom, when general practitioners were equipped with defibrillators by the British Heart Foundation, 70% of cardiac arrest patients were admitted to hospital, and out of these, 60% were discharged alive (5). The American Heart Association emphasises the critical role of timely CPR, stating that the chances of survival decrease by 7-10% for every minute without CPR intervention (6). These statistics underscore the importance of early recognition, prompt CPR, and the availability and use of AEDs in improving survival rates for OHCA patients.

Indeed, general practitioners (GPs) have a crucial role to play in the management of OHCA, particularly in primary healthcare settings where they may be the first healthcare professionals to encounter such emergencies (7). Research conducted by Colquhoun et al. highlighted the impact of

training GPs and equipping them with defibrillators. They reported the outcomes of 555 self-reported resuscitation attempts by GPs, revealing that 27% of patients were discharged alive from hospital (8).

The information available on the incidence and outcomes of OHCA is limited and fragmented, particularly in Malaysia. The frequency of bystander CPR remains largely unknown in the country (9). A study conducted by Chew et al. (10), involving a small sample size, revealed that only 2 out of 23 patients (8.7%) suffering from OHCA received CPR before arriving at the hospital. Unfortunately, neither of these patients survived. Another study by Chew et al. (11), which focused on medical and dental students, indicated that only 51.4% of medical students and 45.5% of dental students were willing to perform bystander CPR. Rahman et al. (12) conducted a study on secondary school students and reported that, prior to any interventions, these students exhibited acceptable knowledge of and attitudes towards CPR.

According to the recent PAROS (Pan-Asian Resuscitation Outcomes Study) conducted in 2015, the incidence of shockable rhythms in OHCA cases varied between 4.1% and 19.8% across different Asian countries (13). Bystander CPR rates also exhibited variation, ranging from 10.5% to 40.9% among the participating countries. However, the study reported that less than 1.0% of OHCA cases received bystander defibrillation.

In Malaysia specifically, the frequency of bystander CPR was reported to be 22.6%, which is lower than rates observed in Japan (40.2%), Korea (40.9%), Singapore (24.3%), Thailand (15.8%), Taiwan (31.4%), and the United Arab Emirates (10.5%). Unfortunately, the data on bystander defibrillation rates in Malaysia is not available. These findings emphasise the importance of increasing bystander CPR rates and promoting the use of AEDs in the community. Efforts should be directed towards improving public awareness, providing CPR training, and ensuring widespread availability of AEDs to enhance the chances of survival in OHCA cases.

Training and re-certification are key factors in ensuring that general practitioners are equipped to effectively manage cardiac arrest cases. Regular training and re-certification programs help them stay updated with the latest guidelines and techniques in resuscitation. It is important to note that despite feeling confident after training, skills retention may decline over time if not reinforced and practiced regularly (14, 15).

The existing studies on knowledge and attitudes regarding cardiopulmonary resuscitation (CPR) in Malaysia have primarily focused on secondary school children and medical and dental students (10-12). However, limited research exists on the knowledge and attitudes of general practitioners (GPs) in this area. Therefore, this study aims to fill this gap by assessing the knowledge and attitudes of GPs in Melaka towards CPR and defibrillation. By exploring the knowledge and attitudes of GPs, this study aims to provide valuable insights into their understanding and perception

of CPR and defibrillation. The findings of this study will contribute to a better understanding of the current state of knowledge and attitudes among GPs, which can help in planning future educational activities.

Materials and Methods

This cross-sectional study was conducted from 01 February 2018 to 29 November 2018, and involved 117 general practitioners practicing in Melaka. The participants were selected from the directory of registered general practitioners in Melaka, as obtained from Unit Kawalan Amalan Perubatan Swasta (UKAPS), Jabatan Kesihatan Negeri, Melaka. The convenience sampling method was employed for participant recruitment. The inclusion criteria were general practitioners who owned a clinic in Melaka, while locum doctors were excluded from the study.

Research tool

A validated questionnaire, adapted from Ong et al. (16), was used to collect data, focusing on the knowledge and attitude towards cardiopulmonary resuscitation and defibrillation among Asian primary healthcare physicians. The questionnaire consisted of 33 questions, categorised into four sections: demographics, knowledge, attitude, and CCR-only resuscitation VS CPR. In assessing knowledge, respondents who correctly answered 8 out of 10 questions were considered to have a good knowledge. As for attitude, a positive attitude was defined as agreement by at least 50% of the respondents with the questionnaire (16, 17)

Data collection

Sample subjects were selected from the General Practitioners directory obtained from UKAPS, Melaka State Health Department. They were contacted via telephone to ascertain their participation and time of availability. To maintain anonymity, each participant was assigned a number from 1 to 117. Then, the investigator personally visited each clinic at the allocated time with the questionnaire and a written consent form. Participants were given the choice to complete the questionnaire on the spot or to return it to the investigator the following day. Additionally, sample subjects were selected from general practitioners who had participated in courses organised by the Melaka State Health Department.

The study received approval from the ethics committee of Universiti Sains Malaysia (USM/JEPeM/17060293). The collected data were analysed using IBM SPSS software. Descriptive analysis with frequency tables and binary logistic regression analysis were employed for data analysis.

Results

A total of 117 general practitioners participated in this study and completed the questionnaire. The demographic characteristics of the study population are summarised in Table 1. Among the 117 respondents, 41% were male, while the remaining 59% were female. In terms of specialisation,

25.6% of the participants had specialised in family medicine, and 12% were internal medicine physicians. Regarding training in basic life support (BLS), 77% of the respondents reported receiving BLS training, and out of those, 71.4% still held a valid BLS certificate. On the other hand, only 58.1% of the general practitioners had received training in advanced cardiac life support (ACLS), with 57.3% holding a valid ACLS certificate. Concerning the availability of automated external defibrillators (AEDs), only 23.9% of the respondents reported having an AED in their clinic. Furthermore, only 21.4% of the participants had used their AED in responding to cardiac arrest cases.

and 77.8% agreed with the compression-to-ventilation ratio of 30:2 for adult and 15:2 for paediatric populations, respectively. Additionally, 82.9% were aware of the effective chest compression criteria, and 81.2% knew about the rhythm check between compressions. Regarding AED training, 82.1% of the respondents reported attending AED training, and 84.6% claimed to know how to operate the AED. However, only 18.2% of the GPs were aware that AEDs do not require an operator to interpret ECG rhythms. These findings highlight the gaps in knowledge regarding CPR and defibrillation among these general practitioners. While there is a relatively good understanding of certain aspects of CPR, there are areas, such as the use and interpretation of AEDs, where further education and training are needed.

Table 1: Sociodemographic characteristics of study sample

Variables		n (%)
Age (mean ± sd)		40.45 ± 6.65
Years of practice (mean ± sd)		16.8 ± 4.75
Gender	Male	48 (41%)
	Female	69 (59%)
Race	Malay	44(37.6%)
	Chinese	45 (38.4%)
	Indian	28 (24.0%)
	Others	
Specialist training	Family medicine	30 (25.6%)
	Internal medicine	14 (12.0%)
	General medicine	18 (15.4%)
	Others	55 (47.0%)
Type of practice	Family practice	57 (48.7%)
	Company practice	38 (32.5%)
	Industrial practice	22 (18.8%)
Trained in BLS		91 (77.8%)
	Validity	65 (71.4%)
Trained in ACLS		68 (58.1%)
	Validity	39 (57.3%)
Has AED in clinic		28 (23.9%)
Uses clinic's AED on cardiac arrest patient		6 (21.4%)

Regarding the respondents' knowledge of CPR and defibrillation, the results showed that only a small percentage, specifically 5.1%, answered all 10 questions correctly, as shown in Table 2. While 70.9% of the respondents agreed that defibrillation was the most important intervention in cardiac arrest, only 24.8% knew that it was not recommended in cases of asystole. In terms of CPR-related knowledge, the majority of the respondents answered several questions correctly. Specifically, 80.3%

Table 2: Respondents' knowledge of CPR and defibrillation.

Variables	n (%)
Obtained correct answer to the following questions	
Q1. What does abbreviation of A in AED represent?	112(95.7%)
Q2. What does abbreviation of E in AED represent?	104(88.9%)
Q3. What does abbreviation of D in AED represent?	116(99.1%)
Q4. AED requires operator to be able to interpret ECG rhythms	22(18.2%)
Q5. Defibrillation is the most important intervention in cardiac arrest	83(70.9%)
Q6. Compression: ventilation ratio with two rescuers for adult CPR is 30:2	94(80.3%)
Q7. Compression: ventilation ratio with two rescuers for paediatric patient CPR is 15:2.	91(77.8%)
Q8. Effective chest compression is one with 100 compressions in 1 minute and allows for complete chest recoil and minimizes interruptions in chest compression.	97(82.9%)
Q9. Rescuers need to provide about 5 cycles (or about 2 minutes) of CPR between rhythm checks during treatment of pulseless arrest	95(81.2%)
Q10. Defibrillation is recommended for asystole patient	29(24.8%)
Total score (full score = ten questions answered correctly)	
1	0 (0%)
2	1 (0.85%)
3	3 (2.56%)
4	5 (4.27%)
5	3 (2.56%)

Table 2: Respondents' knowledge of CPR and defibrillation. (continued)

Variables	n (%)
6	3 (2.56%)
7	16 (13.7%)
8	31 (26.5%)
9	49 (41.9%)
10	6 (5.1%)
Knows how to operate AED	99 (84.6%)
Attended AED training	96 (82.1%)

According to the study findings, a high percentage of general practitioners showed willingness and support for the use of AEDs and the implementation of related measures. Specifically, 86% of the respondents expressed their willingness to use AEDs in cardiac cases if they were available, and 88.8% stated their willingness to purchase an AED for their clinic. However, none of them were willing to pay more than US\$3000 (RM 11,884) for an AED. Furthermore, a majority of the respondents (92.3%) agreed that all clinics should be equipped with defibrillators, and 89.7% expressed their support for legislation making it compulsory. Additionally, 99.1% of the respondents showed their willingness to support and participate in community CPR or AED projects. Among the small percentage of respondents who were unwilling to use an AED, 56.2% expressed fear of legal liability, while 32.3% lacked confidence in using the device. For those who were unwilling to purchase an AED, 53.8% cited the cost as the main deterrent, and 38.4% were unsure of how to use the AED. Table 3 provides a summary of further data regarding the attitudes of the respondents. Overall, the findings indicate a positive attitude towards the use of AEDs and support for initiatives aimed at improving cardiac resuscitation outcomes in the community.

Table 3: Respondents' attitudes towards defibrillation.

Variables	n (%)
Willing to use AED to attend to cardiac arrest patient if it is available	101 (86.0%)
Reasons for not using AED	
Does not know what AED is	0 (0.00%)
Fear of legal liability	9(56.2%)
Does not know how to use AED	2(12.5%)
Not confident	5(32.3%)
Willing to buy an AED	104(88.8%)

Table 3: Respondents' attitudes towards defibrillation. (continued)

Variables	n (%)
Willing to pay	
< US\$1000 (RM 3,962)	87(83.7%)
US\$1000 - US\$2999 (RM 3,962 – RM 11,883)	17(16.3%)
US\$3000 - US\$4999 (RM 11,884 – RM 19,807)	0(0.0%)
>US\$5000 (RM 19,808)	0(0.0%)
Not willing to buy AED because	
Too expensive	7(53.8%)
Not useful	0(0.0%)
Difficult to maintain	1(0.8%)
Unsure of how to use	5(38.4%)
Others	0(0.0%)
Would encourage others to buy AED	97(82.9%)
Willing to attend AED training course at own expense	86(73.5%)
Agrees all clinics should be equipped with AED	108(92.3%)
Would support legislation to make defibrillator a compulsory equipment for all clinics	105(89.7%)
Would support/participate in community CPR/AED project	116(99.1%)

According to the study findings presented in Table 4, some significant associations were found between certain factors and the knowledge of CPR and defibrillation among general practitioners. General practitioners who had obtained their degree between 2000 and 2009 demonstrated a good knowledge of CPR and defibrillation ($P = 0.006$). Additionally, those with more than 10 years of practice also demonstrated a good knowledge in this area. Furthermore, general practitioners who had received BLS training had significantly better knowledge of CPR and defibrillation ($P = 0.019$). However, there was no statistically significant relationship between good knowledge and ACLS training or the validity of the certification (BLS or ACLS).

Regarding the mode of resuscitation, as indicated in Table 5, the majority of respondents (71.8%) preferred conventional cardiopulmonary resuscitation (CPR) over chest-compression-only resuscitation (CCR) (28.2%). Among those who chose CPR, 42.9% believed it to be more effective, 35.7% were confident in their CPR techniques, and others selected CPR because it was recommended by the National Resuscitation Council. On the other hand, respondents who preferred CCR cited reasons such as being unwilling to perform mouth-to-mouth ventilation (61%), perceiving CCR as easier to learn (6%), and believing it to be as effective as CPR (33%).

Table 4: Multiple logistic regression analysis of factors associated with a good knowledge of CPR and defibrillation among General Practitioners in Melaka (n = 117).

Variables	Univariate analysis		Multivariate analysis		
	Crude OR	95% CI	Adjusted OR	95% CI	p value
Year Obtained MD/MBBS					
1980-1989	1		1		
1990-1999	1.364	0.112,16.577	1.991	0.138,28.779	0.613
2000-2009	44.00	3.954,489.665	34.304	2.722,432.38	0.006
> 2010	4846424529	0.000	2550564880.823	0.000	0.999
BLS Trained					
No	1		1		
Yes	12.00	4.039,35.649	5.010	1.303,19.259	0.019

Table 5: Comparison between chest compression-only resuscitation and standard cardiopulmonary resuscitation among GPs in Melaka (n = 117)

Variables	n (%)
Would perform mouth-to-mouth ventilation during CPR	84 (71.8%)
Preferred method of resuscitation	
CPR	84 (71.8%)
CCR	33 (28.2%)
Prefers CCR because	
As effective as CPR	11 (33%)
Easier to learn	2 (6.0%)
Unwilling to do mouth-to-mouth ventilation	20 (61.0%)
Prefers CPR because	
More effective	36 (42.9%)
Confident of CPR technique	30 (35.7%)
Recommended by National Resuscitation Council	17 (20.2)
Others	1 (1.2%)

Discussion

This marks the first local study aimed at investigating resuscitation knowledge and attitudes among general practitioners. The findings revealed that the majority of general practitioners (86%) possessed a good knowledge of and recognised the importance of defibrillation. This is in contrast with the findings of a study conducted by Nambiar et al. (18), which reported a low level of knowledge in BLS/ACLS among healthcare professionals in North Kerala, with a mean score of 44.5%. Additionally, it contrasts with a previous South Indian study by Aroor et al. (19), which reported a mean score of 41.6%.

The average age of the general practitioners in Melaka was 40 years old, and they had more than 10 years' experience in the medical field. It was found that the duration of service significantly contributed to an excellent knowledge of CPR and AED ($P = 0.006$). Additionally, 59% of the general practitioners in Melaka were female. The demographic composition of the respondents was well balanced in terms of ethnicity, with 37.6% being Malays, 38.4% being Chinese, and the remaining 24% being Indians.

Out of the 117 general practitioners surveyed, 25.6% were family medicine specialists, and 12.0% were internal medicine specialists. Approximately 78% of the respondents had received previous training in BLS, and 71.4% of them still held a valid certification. In contrast, 58.1% of the respondents had received ACLS training, with 57.3% holding a valid certificate. The possession of BLS and ACLS certification was found to be statistically significant in determining level of knowledge and AED usage in this study ($P = 0.019$). These findings are consistent with a study conducted by Ong et al. in Singapore, which reported that 64% of their respondents were able to answer more than 3 out of 5 questions correctly (16).

We observed that 58.1% of the GPs had received ACLS training, while 77.8% were BLS certified. This difference in percentages could be attributed to the policy developed by the National Committee of Resuscitation Training (NCORT) under the Ministry of Health Malaysia, which mandates BLS certification as part of the training, while trainees are only encouraged to obtain ACLS or ALS certification (20). Interestingly, Olajumoke et al. (17) stated in their study that only 4% of GPs in Osun State, Nigeria, had attended CPR training programs, in contrast to the higher attendance rates of residents (96%) and consultants (16%). This difference in attendance might be attributed to the training locations, which were primarily in tertiary hospitals, potentially explaining the higher percentage of attendance by residents and consultants compared to the lower percentage among GPs.

Our study found that GPs with more than 10 years' experience had better knowledge. This finding is similar to that of the study conducted by Abdulhadi et al. (21), which found that GPs aged over 35 years and with more than ten years' experience obtained higher mean knowledge scores and demonstrated subjective proficiency in operating an AED. This could be attributed to their frequent exposure to BLS training. However, Majid et al. (22) found no association between knowledge and doctors' years of experience. Zamir et al. (23) noted that senior doctors showed decreased knowledge compared to junior doctors, which aligns with the finding by Nambiar et al. (18) that physicians with less than 5 years' experience had significantly higher knowledge scores in BLS/ACLS. Additionally, prior training in BLS/ACLS did not improve the mean score among physicians (18).

Of the respondents, 84% claimed that they knew how to use an AED. However, it was found that only 18.2% knew that an AED is not operator dependent for interpreting ECG rhythms. Additionally, almost 75% of the respondents believed that defibrillation is recommended for asystole patients. The reason behind this contradiction is probably due to the fact that only 23.9% of the general practitioners had an AED available in their clinic, and only 21.4% had ever used an AED when attending to cardiac arrest cases. Therefore, the practical aspect of AED usage appears to be lacking.

One of the reasons for the limited number of clinics having an AED on their premises could be the perceived exorbitant price of an AED. It was observed that 53.8% of the respondents felt that AEDs were expensive and, as a result, were unwilling to purchase them. Among those willing to purchase an AED, 83.7% indicated they would do so if it cost less than US\$1000 or RM 4,000 (\$1 USD = RM3.96). Interestingly, AEDs can be found on eBay at an average price of US\$1500 - US\$2000 (RM 5,940 – RM 7,920).

On the other hand, 14% of the respondents were still unwilling to use an AED, even if it was readily accessible and available in the clinic. This reluctance was mainly due to fear of legal liability (56.2%) and a lack of confidence in operating an AED (32.3%). This finding is comparable to that of the study by Mohd Khairi et al. (24), which showed that 47.2% of their paramedics agreed that a lack of legal coverage was one of the factors affecting their practice and confidence level in relation to AED usage.

However, an encouraging finding was that 73.5% of the respondents were willing to pay for an AED training course out of their own pocket, and 82.9% would encourage others to buy an AED. Additionally, approximately 89.7% would support legislation to make it compulsory to have an AED available in all clinics, and 99.1% of the respondents would support and participate in community programs involving CPR and AED. This is an interesting finding that we cannot fully explain. Nevertheless, it depicts that general practitioners in Melaka have a positive attitude towards

CPR and defibrillation and show their commitment to improving healthcare services.

When it comes to performing mouth-to-mouth ventilation during CPR, only 71.8% of the respondents were willing to do so. Furthermore, 28.2% of the GPs preferred chest compression-only resuscitation. Interestingly, among those who preferred chest compression-only resuscitation, 61% were unwilling to perform mouth-to-mouth ventilation, while 33% believed it was as effective as standard CPR, and 6% found it easier to learn. Although the current local regulation requires clinics to be equipped with emergency drugs, it does not specify the inclusion of a defibrillator or emergency airway equipment. Hence, this lack of requirement may explain the reluctance of general practitioners to perform mouth-to-mouth ventilation, given their access to bag-valve masks.

We also found that 71.8% of the respondents chose standard CPR over chest-compression-only (CCR) resuscitation. This finding is comparable to that of the study by Abdulhadi et al. (21), where 84.9% of their respondents preferred standard CPR. However, in the study by Ong et al. (16), only 47% opted for standard CPR. Majid et al. (22) stated that the majority of their respondents preferred standard CPR over CCR and were reassured because they considered it more effective, but they preferred using some barrier when giving ventilation. This reluctance might be attributed to religious restraints or fears of acquiring airborne or other infections. Our study found that those who preferred standard CPR felt confident with their technique (35.7%) and believed it was more effective (42.9%). They also followed the recommendations provided by the National Resuscitation Council (20.2%). Although a SOS-KANTO study (26) proposed that chest-compression-only resuscitation without ventilation was an alternative for lay rescuers, as it was simpler to teach and resulted in fewer interruptions between chest compressions, the AHA guidelines (2015) still recommend that healthcare providers perform standard CPR (25, 26). This information is essential for future planning and training among GPs.

Limitations

Limitations of the study include the restricted coverage of respondents, as we encountered logistical difficulties in reaching general practitioners in rural areas. The tight time frame for the submission of completed questionnaires could also have affected the actual knowledge level of our respondents, given that the distribution and collection times differed by just one day. Unfortunately, we did not record the submission time in this study, which prevents further analysis of knowledge level over time. Furthermore, since our study did not adopt the probability sampling method, the data collected may not be representative of all general practitioners in Malaysia.

Conclusion

Most of the general practitioners in Melaka have demonstrated a good knowledge of and a positive attitude

towards cardiopulmonary resuscitation and defibrillation. Furthermore, the majority of them prefer standard CPR to CCR. As a result of our findings, we recommend that private clinics be equipped with AEDs, and emphasise the importance of continuous training in cardiopulmonary resuscitation and defibrillation for primary health care providers, especially general practitioners. These measures can contribute to the delivery of better health care services to the public.

Acknowledgements

The authors would like to express their deepest gratitude to Dr Marcus Ong for the invaluable contribution to the questionnaire and to all those directly or indirectly involved in this study.

Financial support

This research did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

The authors report no potential conflict of interest.

References

1. Rea TD, Eisenberg MS, Sinibaldi G, White RD. Incidence of EMS-treated out-of-hospital cardiac arrest in the United States. *Resuscitation*. 2004; 63(1):17-24.
2. AHA Statistical Update. Heart Disease and Stroke Statistics 2023. Available at : <https://www.heart.org/-/media/PHD-Files-2/Science-News/2/2022-Heart-and-Stroke-Stat-Update/2022-Stat-Update-At-a-Glance.pdf>. Accessed 15 June 2023
3. Sasson C, Rogers MA, Dahl J, Kellermann AL. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes*. 2010; 3(1):63-81.
4. Stub D, Smith K, Bray JE, Bernard S, Duffy SJ, Kaye DM. Hospital characteristics are associated with patient outcomes following out-of-hospital cardiac arrest. *Heart*. 2011; 97(18):1489-94.
5. Alessandro Proclemer, Dan Dobreanu, Laurent Pison, Gregory Y.H. Lip, Jesper Hastrup Svendsen, Carina Blomström Lundqvist, conducted by the Scientific Initiative Committee, European Heart Rhythm Association, Current practice in out-of-hospital cardiac arrest management: A European heart rhythm association EP network survey. *EP Europace*. 2012; 14 (8):1195–1198.
6. American Heart Association. CPR & Sudden Cardiac Arrest (SCA) FactSheet. (2011). http://www.heart.org/HEARTORG/CPRAndECC/WhatisCPR/CPRFactsandStatistics_UCM_307542_Article.jsp. 2011. Accessed 2 May 2022
7. Masterson S, Vellinga A, Wright P, Dowling J, Bury G, Murphy AW. General practitioner contribution to out-of-hospital cardiac arrest outcome: A national registry study. *Eur J Gen Pract*. 2015; 21(2):131-7.
8. Colquhoun MC. Defibrillation by general practitioners. *Resuscitation*. 2002; 52(2):143-148.
9. Nurumal M.S & Sheikh Abdul Karim.S. Out of hospital cardiac arrest in Kuala Lumpur: Incidence, adherence to protocol; and issues: A mixed method study. *Malaysian Journal of Public Health Medicine* 2015; 15(3):94-103.
10. Chew KS, Mohd Idzwan Z, Nik Hishamuddin NA, Wan Aasim WA, Kamaruddin J. How frequent is bystander cardiopulmonary resuscitation performed in the community of Kota Bharu, Malaysia? *Singapore Med J*. 2008; 49(8):636-9.
11. Chew KS, Yazid MN. The willingness of final year medical and dental students to perform bystander cardiopulmonary resuscitation in an Asian community. *Int J Emerg Med*. 2008; 1(4):301-9.
12. Rahman NH, Keng Sheng C, Kamauzaman TH, Md Noh AY, Wahab SF, Zaini IZ, *et al*. A multicenter controlled trial on knowledge and attitude about cardiopulmonary resuscitation among secondary school children in Malaysia. *Int J Emerg Med*. 2013; 6(1):37.
13. Ong ME, Shin SD, De Souza NN, Tanaka H, Nishiuchi T, Song KJ, *et al*. PAROS Clinical Research Network. Outcomes for out-of-hospital cardiac arrests across 7 countries in Asia: The Pan Asian Resuscitation Outcomes Study (PAROS). *Resuscitation*. 2015; 96:100-8.
14. Chalkias A, Koutsovasilis A, Mazarakis A, Lelovas P, Kakkavas S, Papadimitriou L, Xanthos T. Cardiac arrest in Greek primary health care and willingness of general practitioners to use automatic external defibrillator. *Resuscitation*. 2011; 82(9):1144-7.
15. Aranzábal-Alegría G, Verastegui-Díaz A, Quiñones-Laveriano DM, Quintana-Mendoza LY, Vilchez-Cornejo J, Espejo CB *et al*. Factors associated to the level of knowledge in cardiopulmonary rejection in hospitals of Peru. *Revista Colombiana de Anestesiología*. 2017; 45(2):114-121
16. Ong ME, Yap S, Chan KP, Sultana P, Anantharaman V. Knowledge and attitudes towards cardiopulmonary resuscitation and defibrillation amongst Asian primary health care physicians. *Open Access Emerg Med*. 2009; 16(1):11-20.
17. Olajumoke To, Afolayan Jm, Raji Sa, Adekunle Ma. Cardiopulmonary Resuscitation - Knowledge, Attitude & Practices In Osun State, Nigeria. *J West Afr Coll Surg*. 2012; 2(2):23-32.
18. Nambiar M, Nedungalaparambil NM, Aslesh OP. Is current training in basic and advanced cardiac life support (BLS & ACLS) effective? A study of BLS & ACLS knowledge amongst healthcare professionals of North-Kerala. *World J Emerg Med*. 2016; 7(4):263-269.
19. Aroor AR, Saya RP, Attar NR, Saya GK, Ravinanthanan M. Awareness about basic life support and emergency medical services and its associated factors among

- students in a tertiary care hospital in South India. *J Emerg Trauma Shock*. 2014; 7(3):166-9.
20. Policy on resuscitation training for Ministry of Health hospitals by National Committee On Resuscitation Training (NCORT) Ministry of Health Malaysia. (2016). Available at: https://www.moh.gov.my/moh/resources/Polisi/POLICY_FOR_RESUSCITATION_TRAINING.pdf. Accessed 4 May 2022
 21. Abdulhadi Al Abdulaziz, Ashraf Al Ramadan, Abdullah Al Ramadan. Knowledge and Attitudes toward Cardiopulmonary Resuscitation and Defibrillation among Primary Health-Care Physicians in Al-Ahsa, Saudi Arabia. *International Journal Of Scientific Study*. 2018; 6(8):41-51.
 22. Majid A, Jamali M, Ashrafi MM, Ul Haq Z, Irfan R, Rehan A, *et al*. Knowledge and Attitude Towards Cardiopulmonary Resuscitation Among Doctors of a Tertiary Care Hospital in Karachi. *Cureus*. 2019; 11(3):e4182.
 23. Zamir Q, Nadeem A, Rizvi AH. Awareness of cardiopulmonary resuscitation in medical-students and doctors in Rawalpindi-Islamabad, Pakistan. *J Pak Med Assoc*. 2012; 62(12):1361-4.
 24. Mohd Khairi, A.L, Nik Azlan, N.M, Faizal Amri, H. 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? *Medicine & Health*. 2018; 13(1):198-207
 25. American Heart Association. Highlights of the 2015 American Heart Association Guidelines Update for CPR and ECC. Available at <https://professional.heart.org/en/science-news/2015-aha-guidelines-update-for-cpr-and-ecc-science>. Accessed 10 July 2022
 26. SOS-KANTO study group. Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study. *Lancet*. 2007; 369(9565):920-926.