The Effect of Cardiopulmonary Resuscitation Clinical Audit on the Patient Survival in the Emergency Room

Jafar Moridi[1], Hosein Mahmoudi[2], Abbas Ebadi[3], Ali Rahmani[1], Seyed Tayeb Moradian[4]

[1]Department of Nursing, Baqiyatallah University of Medical Sciences, [2]Department of Trauma Research Center and Department of Nursing, Baqiyatallah University of Medical Sciences, [3]Department of Behavioral Sciences Research Center, Department of nursing, Baqiyatallah University of Medical Sciences, [4]Atherosclerosis Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran

ORCID:
Jafar Moridi: http://orcid.org/0000-0001-7061-6116
Hosein Mahmoudi: http://orcid.org/0000-0003-4586-3486
Abbas Ebadi: http://orcid.org/0000-0002-2911-7005
Ali Rahmani: http://orcid.org/0000-0003-0323-3857
Seyed Tayeb Moradian: http://orcid.org/0000-0002-7079-5377

Abstract

Background: The ability to perform cardiopulmonary resuscitation (CPR) is among the most important professional skills for physicians and nurses. There is a wide difference among different countries respecting resuscitation success rate. Studies show weaknesses in performing resuscitation. **Objectives:** This study aimed at assessing the effects of clinical audit of CPR in the emergency room based on the Situation Stabilization Model (SSM). **Materials and Methods:** This quasi-experimental study was done in 2017 in the emergency room of Baqiyatallah Hospital, Tehran, Iran. Using the Adib checklist, 35 resuscitations were assessed based on the steps of clinical audit. Then, a 1-month educational program was held for the resuscitation staffs in the study setting. Then, 35 new resuscitations were assessed using the same checklist. Finally, the results of the two measurements were compared. **Results:** There were significant differences between two measurement time points regarding the mean scores of different resuscitation skills ($P < 0.001$). Primary resuscitation success rate increased from 6 (17.1%) cases at baseline to 8 (22.9%) of the cases after the intervention. This increase was not statistically significant ($P = 0.47$). **Conclusions:** Clinical audit in the emergency room based on the SSM improves the quality and the success rate of CPR. The success rate is in our study increased. Furthermore, the reported data were not statistically significant for improving the success rate; it is clinically important. Because primary resuscitation success rate increased from 6 (17.1%) cases at baseline to 8 (22.9%) cases after the intervention. These findings highlight the necessity and the importance of the clinical audit of care services as well as the implementation of educational interventions based on the existing weaknesses. Given the great importance and sensitivity of resuscitation, health-care staffs need to receive regular theoretical and practical in-service resuscitation-related training.

Keywords: Cardiopulmonary resuscitation, clinical audit, emergency room

INTRODUCTION

Cardiac arrest is the leading cause of about 60% of deaths among patients with cardiovascular diseases.[1] The postarrest survival rate is about 5%. One of the major factors affecting post-arrest survival is the quality of cardiopulmonary resuscitation (CPR).[2] Any one minute delay in starting the CPR reduces the survival rate 2.2%.[3] Moreover, the quality of CPR as well as CPR technicians' competence is among the most important factors behind CPR outcomes.[4]

The results of studies on medical and nursing students revealed that they had limited CPR-related knowledge and skills.[5-7] Moreover, another study showed that although senior medical residents had moderate-level knowledge about basic and advanced CPR, they were unable to appropriately

Address for correspondence: Dr. Hosein Mahmoudi, Trauma Research Center and Faculty of Nursing, Baqiyatallah University of Medical Sciences, Tehran, Iran.
E-mail: h.mahmoudi@bmsu.ac.ir

Access this article online

Quick Response Code:

Website:
www.archtrauma.com

DOI:
10.4103/atr.atr_58_18

use their CPR-related knowledge and skills, particularly the ventilation-compression ratio.[8]

There is a wide difference among different countries regarding post-CPR survival rate.[9-13] The results of a study in Iran indicated that primary CPR success rate was 15.3%, from which 10.6% of patients were discharged. Follow-up assessments of the discharged patients revealed that only 8% of them survived during the first 6 months after hospital discharge.[14] The results of another study indicated that 64.4% of patients died during CPR, 28.4% of them survived only several minutes, and just 7.2% of them had a long-term survival, from which 2.8% developed brain lesions.[15] Another study revealed that most CPRs were futile (93%) and just a few patients who had undergone CPR were discharged from hospital either with or without brain lesions (1% and 6.5%, respectively).[16] Moreover, Dolatabadi *et al.* found that 63% of resuscitated patients experienced death and only 27% were discharged.[17] Idris *et al.* also did a study on 10371 patients with out-of-hospital cardiac arrest and reported that blood circulation restoration as well as 24-h survival and discharge rates were 34% and 9%, respectively.[18] These rates in a study made by Razi *et al.* were 55% and 12%, respectively.[19] Miranzadeh *et al.* also reported that 95.2% of CPRs in their setting were unsuccessful and only 4.8% of patients who had undergone CPR survived to hospital discharge.[2]

Despite the wealth of studies into CPR success and post-CPR discharge rates, there are limited information about the quality of performing CPR and the accordance of performed CPRs with the existing standards and guidelines. One of the models which can be used to evaluate the quality of CPRs is the Situation Stabilization Model (SSM). SSM holds that stabilization is a dynamic process which starts as early as patient entrance into the emergency room, focuses on nurses, patients, and family members' behaviors, and finally results in situation stabilization. SSM assesses realities, functions, and factors behind care provision.

One of the main components of SSM is clinical audit. Through the clinical audit, the quality of health-care providers' clinical practice is constantly compared with clinical standards and guidelines and then, appropriate measures are taken to promote their practice. Consequently, it helps maintaining the stability of patients, nurses, and health-care organizations, enhances care quality, and improves patients' health.[20-23] The steps of clinical audit include: choosing the area of auditing, assessing the status quo, identifying standards, comparing the status quo with the standards, developing and implementing appropriate measures, and re-auditing.[24,25]

Objectives
Considering the poor quality of CPR performance and available data about the role of clinical audit, the present study was made to assess the effects of SSM-based clinical audit of CPR in the emergency room.

MATERIALS AND METHODS
Study design, sample, and setting
This quasi-experimental study was done from February to November 2017 in the emergency room of Baqiyatallah Hospital, Tehran, Iran. The study population consisted of patients who were transferred to the emergency room to undergo CPR. In addition, medical staffs that were the member of the CPR team were included. Patients were included if they aged eight or more, were diagnosed with respiratory and cardiac arrest and needed CPR.

Based on mean and standard deviation reported in a previous study,[26] and considering an α of 0.5, a power of 90%, and a β of 10%, the Altman Nomogram showed that 35 patients were needed for each group. Participants were recruited to the study consecutively using the census method. Totally 70 cases, 35 before intervention and 35 cases after the intervention were included. The study protocol was approved by the Ethics Committee of Baqiyatallah University of Medical Sciences, Tehran, Iran, (ethics approval code: IR. BMSU. REC.1394.145). The study has also registered at Iranian registry for clinical trials (IRCT201507012730N6).

The study objectives were explained to the medical staffs who were invited to participate in the study, and the informed consent was obtained.
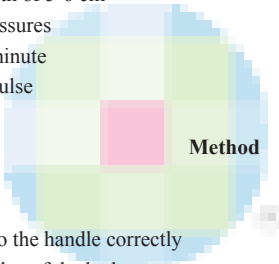
Initially, 35 cases of CPR done from February to May 2017, in the study, setting was assessed using a standard checklist (the control group). The researcher was standing in the corner of the CPR room and assessed the CPR quality based on the checklist. He did not have any role in implementing the CPR. After that, a focus group with research team members was done and accordingly, the weaknesses in the practice of the CPR team were identified. Then, a 1-month educational program was implemented in June 2017 for CPR staffs in the study setting based on the results of primary assessments. The program was taught by an emergency medicine specialist. Educational materials were provided through the lecture method, video presentation, pamphlets, and practical exercises. After the program, 35 new cases of CPR were assessed from July to October 2017 using the same checklist (the intervention group).

Data collection tool was a basic and advanced CPR skills checklist which covered different aspects of CPR including chest compression and artificial ventilation (19 items), endotracheal intubation (14 items), defibrillator use (15 items), and CPR management (3 items). The instrument developed by Adib-Hajbaghery and its content validity ratio and index of the checklist were reported to be 0.85 and 0.89, respectively [Table 1].[11] In addition, an outcome of CPR such as the success of CPR was recorded.

Data management and analyses
The data were analyzed using the SPSS software (Version 16.0., Chicago, SPSS Inc) and by running the Chi-square and the independent-sample *t*-tests.

Moridi, *et al*.: Clinical audit of cardiopulmonary resuscitation

Table 1: Adib-Hajbaghery's cardiopulmonary resuscitation skills checklist and skill successfully demonstrated before and after intervention

CPR skills		Details	Skill successfully demonstrated			
			Before intervention		After intervention	
			Yes (%)	No (%)	Yes (%)	No (%)
Circulation	1	Checking the pulse of the patient	100	0	100	0
	2	Is the breathing fast or slow, shallow or deep? Is breathing trouble for the person	83	17	97	3
	3	Requesting help or calling the rescue team	100	0	97	3
	4	Put the patient on a rigid surface	97	3	97	3
	5	Open the airway with bending head backward (head tilt-chin lift by placing a one hand under the neck and another hand on the forehead) (investigating the possibility of damage to the cervical spine)	91	9	94	6
	6	Cleaning the air way with finger	37	63	77	23
	7	Choosing the appropriate airway	74	26	77	23
	8	Stands beside the patient	97	3	100	0
	9	Giving the respiration	88.5	11.5	100	0
	10	Blocking the patient's nose in mouth-to-mouth breathing	40	60	83	17
	11	Determines the point of massaging the heart on the sternum	94	6	94	6
	12	During massage, his fingers do not touch the chest	94	6	97	3
	13	Avoid lifting or shaking hands, between massage	91.5	8.5	100	0
	14	During massage, it uses a vertical force and its weight	91.5	8.5	88.5	11.5
	15	It provides 2 artificial respiration for every 30 massages	100	0	100	0
	16	Compression of the chest at a depth of 5-6 cm	80	20	88.5	11.5
	17	Rhythmicity and regularity of pressures	71.5	28.5	91	9
	18	Massages at least 100 times per minute	88.5	14.5	94	6
	19	Every 2 min, checks the carotid pulse	94.5	5.5	100	0
		Mean=…………….	84.74	15.26	93.43	6.57
Intubation		**Method**				
	1	Selects the appropriate tube size	88.5	8.5	97	3
	2	Selects the appropriate blade	100	0	100	0
	3	Connect the laryngoscope blade to the handle correctly	100	0	100	0
	4	The head of the patient lays the edge of the bed	94.5	5.5	97	3
	5	Extends the patient's head	100	0	97	3
	6	Holds the laryngoscope with the left hand and the tube in the right hand	100	0	100	0
	7	The laryngoscope moves forward without leveraging on the teeth	100	0s	100	0
	8	By looking at the epiglottis, the laryngoscope is pulled in the middle of the mouth	97	3	94	6
	9	The tracheal tube is inserted 15-18 cm	85.5	14.5	97	3
	10	The cuff of the endotracheal tube is filled with 4-5 cc air	100	0	97	3
	11	Auscultate the apex of the lungs	94.5	5.5	100	0
	12	Fixes the tube correctly	97	3	97	3
	13	All steps take up to 45 s	91.5	8.5	100	0
	14	Inserts the air way	74.5	25.5	100	0
		Mean=…………….	94.72	5.28	98.29	1.71
		Method				
How to use defibrillator	1	Places the patient in supine position	74.5	25.5	100	0
	2	The pulse is evaluated for its absence	68.5	31.5	100	0
	3	It ensures that the patient does not come in contact with flat metal parts	96	4	100	0
	4	Covers the pedals place on the chest with gel	91.5	8.5	100	0
	5	Turns on the power key	96	4	100	0
	6	Put the pedals on the chest, the heart rhythm is observed on the screen for fibrillation	96	4	97	3
	7	Selects the amount of energy needed	96	4	100	0
	8	Press the charging button and stops 2-6 s to save energy	96	4	100	0

Contd...

Moridi, *et al.*: Clinical audit of cardiopulmonary resuscitation

Table 1: Contd...

CPR skills		Details	Skill successfully demonstrated			
			Before intervention		After intervention	
			Yes (%)	No (%)	Yes (%)	No (%)
How to use defibrillator		**Method**				
	9	After completion of energy storage (the end of the device whistle) warns everyone to go back. It is assured of the lack of contact with the bed and the patient	91.5	8.5	100	0
	10	Keeps apex pedal in the right hand and the sternum pedal in the left hand, then keeps one pedal on right sternum and other on apex	96	4	100	0
	11	It ensures that pedals are not in contact with each other	96	4	100	0
	12	Press the pedals firmly into the chest	96	4	100	0
	13	Press the discharge button	96	4	100	0
	14	Immediately checks the rhythm on the monitor	96	4	100	0
	15	If the previous rhythm continues, it will provide the second shock in the same way as before	91.5	8.5	100	0
		Mean=.................	93.54	6.46	99.8	0.2
Resuscitation management		**Method**				
	1	Request for the preparation of a defibrillator	91.5	8.5	100	0
	2	Request to get an peripheral vessel	97	3	100	0
	3	Nonstop resuscitation until heart and pulse return or the order of extermination or exhaustion of the savior	97	3	100	0
		Mean=.................	95.2	4.8	100	0

CPR: Cardiopulmonary resuscitation

RESULTS

In total, 70 cases of CPR ware assessed most CPRs were performed at the night shift (38.6%) and on male patients (68%). Most patients suffered from internal medicine disorders. The means of patients' age in control and the intervention groups were 62.5 ± 17.2 and 67.2 ± 18.4, respectively. Moreover, CPRs in these groups lasted on average, 41.4 ± 14.5 and 36.4 ± 7.4 min, respectively. There were no significant differences between the control and the intervention groups respecting patients' gender, age, and underlying conditions as well as the length of CPR and the working shifts in which CPRs were performed ($P > 0.05$).

In some skills, such as pulse check, aid request, and compression to ventilation ration, the staff matched with standards completely. However, they had lower competencies in the airway management skills such as cleaning the airway before breathing. These skills were improved after the intervention.

Table 1 shows the percentage skill successfully demonstrated before and after the intervention.

Table 2 shows the pretest and posttest mean scores of CPR skills. The results of the paired *t*-test showed that the groups differed significantly from each other respecting the total score of CPR skills as well as the score of its chest compression dimension ($P < 0.001$). Baseline success rate (i.e., in the control group) was 17.1% (6 cases). After the intervention (i.e., in the intervention group), this rate increased to 22.9% (8 cases). However, the results of the Chi-square test

Table 2: The mean scores of different dimensions of cardiopulmonary resuscitation

Groups CPR dimensions	Mean±SD		The results of the independent-sample *t*-test
	Control	Intervention	
Chest compression	16.1±2.2	17.8±1.4	$t=-3.7$ $P<0.001$ *t*-test
Endotracheal intubation	13.6±1.9	13.7±0.54	$t=-0.47$ $P=0.65$ *t*-test
Defibrillator use	14.3±2.4	14.9±0.16	$t=-1.5$ $P=0.13$ *t*-test
CPR management	2.8±0.43	3±0.0	$t=-1.99$ $P=0.13$ *t*-test
Total score	46.4±4.5	49.5±17	$t=-3.7$ $P<0.001$ *t*-test

CPR: Cardiopulmonary resuscitation, SD: Standard deviation

Table 3: The frequency distribution of cardiopulmonary resuscitation outcomes

Outcome Group	Successful resuscitation	Death	The results of the Chi-square test
Control	6 (17.1)	29 (82.9)	$\chi^2=0.52$
Intervention	8 (22.9)	27 (77.1)	$P=0.47$

indicated no significant between-group difference regarding CPR success rate [$P = 0.47$; Table 3].

DISCUSSION

Our results illustrated that SSM-based clinical audit of CPR increased CPR success rate from 17.1% (6 cases) to 22.9% (8 cases). Moreover, it improved the scores of the chest compression, defibrillator use, and management dimensions of CPR. In line with our findings, Asadi and Pollard also reported that intensive evidence-based training and exercises improved CPR staffs' interpersonal coordination, reduced the rate of doing undue tasks, and increased CPR success rate.[27] Sadeghi and Saffarzadeh also found that training CPR staffs significantly improved CPR quality.[28] Adib-Hajbaghery also reported improved CPR quality following interventions such as practical CPR training, CPR exercises, and periodical CPR evaluations.[29] Similarly, Dal reported that regular CPR training, constant supervision, and exercising CPR skills in regular intervals significantly improved CPR quality.[30]

The results of the above-mentioned studies indicate that CPR quality can be improved through the careful supervision of all CPR steps as well as the correction of errors and faults. Although most studies reported the effectiveness of educational interventions in improving CPR quality, the depth and the stability of learning may vary based on the methods of providing educations. The most important factor behind the effectiveness of educational interventions is to provide educations based on the weaknesses of CPR staffs. Systematic evaluation, identification, and minimization of weaknesses can save money and time and improve CPR quality. Our findings revealed that even competent and specialized CPR staffs may have weaknesses. However, the clinical audit can help identify and overcome such weaknesses and thereby, it can produce better CPR outcomes. Through critical analysis of the quality of the provided care services, clinical audit not only directly improves the quality of the services but also can be used as an educational tool as well as a mechanism for further advances.

Previous studies reported that CPR success rate varied widely in different settings. For instance, Dolatabadi *et al.* reported that 93% of CPRs were unsuccessful and only 7% of 64 resuscitated patients were discharged from hospital either with or without brain lesions (6.5% and 1%, respectively).[17] Salari *et al.* also reported that 64.4% of patients who had undergone CPR experienced death, 28.4% had a short-term survival, and only 7.2% had a long-term survival. They also reported that 2.8% of the survived patients had brain lesions.[31] Primary CPR success rate in other studies was reported to be 32%,[32] 44%,[33] 52%,[34] 44%,[35] and 46%.[36] Such a wide difference in the CPR success rates in previous studies can be due to the differences in the settings, samples, CPR staffs' competencies, available CPR equipment and facilities, CPR onset time, CPR quality, and success rate assessment protocols in these studies.[37] Further investigations are needed to identify factors behind CPR success rate. In addition, the success rate in this study was not statistically significant, but it seems that increased two people to the survived people is very clinical significant. Hence, the clinical audit and implementing the educational intervention based on its results could improve the quality of care.

The primary CPR success rate in the present study was 17.1% which is almost higher than the previous studies probably due to the fact that in our study setting, most CPRs were led by emergency medicine residents and specialists. Moreover, based on the findings of the previous studies, CPR success rate, in general, has significantly increased in recent years.[38,39]

One limitation was crowded emergency department which was makes it more difficult to collect information during CPR. Other limitations were small sample size in each phase, the short follow-up period of the study, and its nonblind design.

CONCLUSIONS

SSM-based clinical audit in the emergency room improves CPR quality and success rate. Furthermore, the reported data were not statistically significant for improving the success rate, it is clinically important because primary resuscitation success rate increased from 6 (17.1%) cases at baseline to 8 (22.9%) of the cases after the intervention. The success rate is a multifactorial variable that affected with many factors. All factors are not assessed in our study. These findings highlight the necessity and the importance of the clinical audit of care services as well as the implementation of educational interventions based on the existing weaknesses. Given the great importance and sensitivity of CPR and CPR skills, CPR staffs need to receive regular theoretical and practical in-service CPR training. The clinical audit can be used in different clinical settings to improve care quality.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Ibrahim WH. Recent advances and controversies in adult cardiopulmonary resuscitation. Postgrad Med J 2007;83:649-54.
2. Miranzadeh S, Adib-Hajbaghery M, Hosseinpour N. A prospective study of survival after in-hospital cardiopulmonary resuscitation and its related factors. Trauma Mon 2016;21:e31796.
3. Mehra R. Global public health problem of sudden cardiac death. J Electrocardiol 2007;40:S118-22.
4. Mundell WC, Kennedy CC, Szostek JH, Cook DA. Simulation technology for resuscitation training: A systematic review and meta-analysis. Resuscitation 2013;84:1174-83.
5. Mahoori A, Hassani E, Noroozinia H, Amiri Kar M. Evaluating the knowledge of Urmia university medical students about adult cardiopulmonary resuscitation. Urmia Med J 2010;21:260-5.
6. Mäkinen M, Axelsson A, Castrén M, Nurmi J, Lankinen I, Niemi-Murola L, *et al.* Assessment of CPR-D skills of nursing students in two institutions: Reality versus recommendations in the guidelines. Eur J Emerg Med 2010;17:237-9.
7. Josipovic P, Webb M, McGrath I. Basic life support knowledge of undergraduate nursing and chiropractic students. Aust J Adv Nurs 2009;26:58.

8. Kumari KM, Amberkar MB, Alur SS, Bhat PM, Bansal S. Clinical awareness of do's and don'ts of cardiopulmonary resuscitation (CPR) among university medical students – A questionnaire study. J Clin Diagn Res 2014;8:MC08-11.

9. Borimnejad L, Nikbakht Nasrabadi A, Mohammadi Mohammadi H. The effect of cardiopulmonary resuscitation workshop on nurses' sustained learning. Iran J Med Educ 2008;7:209-15.

10. Khoshrang H, Heidarzadeh A, Asadi A. Assessment of the effects of education in clinical skills center on cardiopulmonary resuscitation knowledge of physicians and nurses working in educational therapeutic centers of guilan university of medical sciences in 2004. Res Med Educ 2007;7:7-13.

11. Adib-Hajbaghery M. Longitudinally investigation of the skills of cardiopulmonary resuscitation in nurse interns of Kashan University of Medical Sciences. Iran J Cardiovasc Nurs 2014;3:6-17.

12. Bekhradian N, Khalili A, Bargrizan S, Motlagh AH, Paymard A, Vahdatnejad J. Comparison of knowledge of medical and paramedical intern about of CPR, 2015. Health Sci 2016;5:128-31.

13. Omidifar N, Yamani N, Changiz T. The efficacy of new method of cardiopulmonary resuscitation training in promoting knowledge and skills of 4th year medical students. Iran J Med Educ 2008;8:23-31.

14. Goodarzi A, Jalali A, Almasi A, Naderipour A, Kalhorii RP, Khodadadi A. Study of survival rate after cardiopulmonary resuscitation (CPR) in hospitals of Kermanshah in 2013. Glob J Health Sci 2014;7:52-8.

15. Salari A, Mohammadnejad E, Vanaki Z, Ahmadi F. Survival rate and outcomes of cardiopulmonary resuscitation. J Crit Care Nurs 2010;3:1-2.

16. McKibbon KA. Evidence-based practice. Bull Med Libr Assoc 1998;86:396-401.

17. Dolatabadi AA, Setayesh A, Zare M, Hosseinnejad A, Bozorgi F, Farsi D. Descriptive analysis of contributing factors in outcomes of emergency department CPRs. Crit Care 2005;9:P302.

18. Idris AH, Guffey D, Pepe PE, Brown SP, Brooks SC, Callaway CW, *et al.* Chest compression rates and survival following out-of-hospital cardiac arrest. Crit Care Med 2015;43:840-8.

19. Razi RR, Churpek MM, Yuen TC, Peek ME, Fisher T, Edelson DP, *et al.* Racial disparities in outcomes following PEA and asystole in-hospital cardiac arrests. Resuscitation 2015;87:69-74.

20. Shamsi V, Mahmoudi H, Sirati Nir M, Babatabar Darzi H. Effect of job specialization on the hospital stay and job satisfaction of ED nurses. Trauma Mon 2016;21:e25794.

21. Moayed MS, Mahmoudi H, Ebadi A, Sharif Nia H. Stress and fear of exposure to sharps in nurses. Iran J Psychiatry Behav Sci 2016;10:e3813.

22. Mahmoudi H, Mohammadi E, Ebadi A, Taheri F. Stabilizing the situation in an emergency ward: A grounded theory study of how emergency nurses provide care in emergency wards. Crit Care Nurs J 2017;10:e11603.

23. Moayed MS, Mahmoudi H, Ebadi A, Salary MM, Danial Z. Effect of education on stress of exposure to sharps among nurses in emergency and trauma care wards. Trauma Mon 2015;20:e17709.

24. Levy B, Rockall T. The role of clinical audit in clinical governance.

25. Surgery (Oxford). 2009;27:367-70.

26. Vahidi RG, Tabrizi JS, Iezadi S, Gholipour K, Mojahed F, Rasi V. Organizational facilitators and barriers to implementing effective clinical audit: Systematic review. Journal of Pakistan Medical Students 2013;3:38-45.

27. Kavosi A. Effect of continuing education competency-based program for emergency nurses on rate CPR successful. Q J Nurs Manage 2015;4:19-28.

28. Asadi HK, Pollard J. Fully successful resuscitation despite prolonged cardiac arrest. Saudi J Anaesth 2011;5:314-6.

29. Safari S, Tabrizi JS, Rouhi AJ, Sadeghi-Ghyassi F, Ghojazadeh M, Rouhi AH, *et al.* Family members' attitudes regarding family presence during resuscitation of adults: A systematic review and meta analysis. Ann Anesthesiol Crit Care 2016;1:e10204. DOI: 10.5812/aacc.10204.

30. Kohpaye Zadeh J, Mehrabi H, Ranjbar H, Shoghi M, Zeighami Mohammadi S. The effect of multi-media educational software on learning basic principles of cardio-pulmonary resuscitation (CPR) in nursing students. J Crit Care Nurs 2014;7:160-7.

31. Dal U, Sarpkaya D. Knowledge and psychomotor skills of nursing students in North Cyprus in the area of cardiopulmonary resuscitation. Pak J Med Sci 2013;29:966-71.

32. Salari A, Mohammad Nejad E, Vanaki Z, Ahmadi F. Effect of in-hospital cardiopulmonary cerebral resuscitation management on resuscitation outcomes. J Crit Care Nurs 2011;4:13-22.

33. Assar S, Husseinzadeh M, Nikravesh AH, Davoodzadeh H. The success rate of pediatric in-hospital cardiopulmonary resuscitation in Ahvaz training hospitals. Scientifica (Cairo) 2016;2016:9648140.

34. Peberdy MA, Kaye W, Ornato JP, Larkin GL, Nadkarni V, Mancini ME, *et al.* Cardiopulmonary resuscitation of adults in the hospital: A report of 14720 cardiac arrests from the national registry of cardiopulmonary resuscitation. Resuscitation 2003;58:297-308.

35. Eftychiou C, Georgiou M, Andreou A, Michaelides A, Yiangou K, Deligeorgis A, *et al.* Nicosia general hospital cardiac arrest team: First year's practice and outcomes of in-hospital resuscitation. Hellenic J Cardiol 2009;50:264-8.

36. Singh S, Namrata AG, Gautam PL, Luthra N, Tanwar G, Kaur A. Evaluation of cardiopulmonary resuscitation (CPR) for patient outcomes and their predictors. J Clin Diagn Res 2016;10:UC01-4.

37. Fennelly NK, McPhillips C, Gilligan P. Arrest in hospital: A study of in hospital cardiac arrest outcomes. Ir Med J 2014;107:105-7.

38. Cooper S, Janghorbani M, Cooper G. A decade of in-hospital resuscitation: Outcomes and prediction of survival? Resuscitation 2006;68:231-7.

39. Ozcan V, Demircan C, Engindenizi Z, Turanoglu G, Ozdemir F, Ocak O, *et al.* Analysis of the outcomes of cardiopulmonary resuscitation in an emergency department. Acta Cardiol 2005;60:581-7.

40. Gombotz H, Weh B, Mitterndorfer W, Rehak P. In-hospital cardiac resuscitation outside the ICU by nursing staff equipped with automated external defibrillators – The first 500 cases. Resuscitation 2006;70:416-22.