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

Jafar Moridi¹, Hosein Mahmoudi², Abbas Ebadi³, Ali Rahmani¹, Seyed Tayeb Moradian⁴
¹Department of Nursing, Baqiyatallah University of Medical Sciences, ²Department of Trauma Research Center and Department of Nursing, Baqiyatallah University of Medical Sciences, ³Department of Behavioral Sciences Research Center, Department of nursing, Baqiyatallah University of Medical Sciences, ⁴Atherosclerosis Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran

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...
use their CPR-related knowledge and skills, particularly the ventilation-compression ratio.[19]

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.[20]

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].[31] 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.
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 (%)             |
| Circulation                    |                                                                         |                                 | Yes (%)             | No (%)             |
| 1 Check the pulse of the patient | 100                                                                     | 0                               | 100                 | 0                  |
| 2 Is the breathing fast or slow, shallow or deep? | 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) (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 massaging, 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 massaging, 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                      |                                                                         |                                 | Yes (%)             | No (%)             |
| 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 |
| How to use defibrillator       |                                                                         |                                 | Yes (%)             | No (%)             |
| 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...
In total, 70 cases of CPR were assessed. Most CPRs were performed at the night shift (38.6%) and on male patients (68%). Most patients suffered from internal medicine disorders. The mean age of patients in the control and intervention groups was 62.5 ± 17.2 and 67.2 ± 18.4, respectively. Furthermore, 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 regarding patients’ age, gender, 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 ratio, 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 indicated no significant between-group difference regarding CPR success rate (*P* = 0.47; Table 3).

### Results

In total, 70 cases of CPR were assessed. Most CPRs were performed at the night shift (38.6%) and on male patients (68%). Most patients suffered from internal medicine disorders. The mean age of patients in the control and intervention groups was 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 regarding patients’ age, gender, and underlying conditions as well as the length of CPR and the working shifts in which CPRs were performed (*P* > 0.05).

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| CPR skills | Details | Skill successfully demonstrated |
|------------|---------|-------------------------------|
|            |         | Before intervention | After intervention |
|            | Yes (%) | No (%) | Yes (%) | No (%) |
| How to use defibrillator | | | | |
| 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 |

### 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 | *t* | *P* |
| Chest compression | 16.1±2.2 | 17.8±1.4 | *t* =−3.7 | *P* <0.001 |
| Endotracheal intubation | 13.6±1.9 | 13.7±0.54 | *t* =−0.47 | *P* =0.65 |
| Defibrillator use | 14.3±2.4 | 14.9±0.16 | *t* =−1.5 | *P* =0.13 |
| CPR management | 2.8±0.43 | 3±0.0 | *t* =−1.99 | *P* =0.13 |
| Total score | 46.4±4.5 | 49.5±17 | *t* =−3.7 | *P* <0.001 |

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

CPR: Cardiopulmonary resuscitation, SD: Standard deviation
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). [31] Safali 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. [32] Primary CPR success rate in other studies was reported to be 32%, [33] 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 multifatorial 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.

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Conflicts of interest

There are no conflicts of interest.

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