

Full Length Research Paper

Evaluating Emergency Nurses' Performance of Cardiopulmonary Resuscitation: An Investigation from Egypt

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Abstract

Aim: This is an observational study aimed to evaluate emergency nurses' performance of cardiopulmonary resuscitation (CPR) in emergency department of an Egyptian hospital. **Sample:** The study involved thirty seven nurses recruited from the emergency department. **Data collection:** Data were collected using emergency nurses' performance of CPR observation checklist which covers all steps of CPR categorized under five caring domains including 'assessment', 'preparation', 'implementation', 'post care' and 'documentation'. **Results:** The study showed that the majority of emergency nurses were incompetent in performing most steps of CPR. Additionally, nurses did not comply with the hospital's guidelines in many aspects of resuscitation care such as the quality of cardiac compressions, timing of adrenaline administration and standard precautions. Nurses' gender, qualifications, years of work experience and CPR training affected their performance. **Conclusion:** Basic and advanced life support courses should be mandatory for all emergency nurses. To maintain emergency nurses' resuscitation skills, refreshers CPR training sessions should be organized for them. Nurses' CPR performance should be periodically evaluated and linked to their annual increment.

Key words: Cardiopulmonary resuscitation, Emergency nurses, Emergency department, Nurses' performance

Introduction

Cardiac arrest is a medical emergency associated with high morbidity and mortality rates (Shi, Jo, Song, Sim & Song, 2012). CPR is a keystone in management of cardiac arrest (Abella, 2016). It is an emergency life-saving procedure used to restore circulatory blood flow and breathing in cardiac or respiratory arrested patient (The British Medical Association & the Royal College of Nursing, 2016).

The outcome of in-hospital cardiac arrests are affected by the quality of resuscitation team training, compliance with evidence-based CPR guidelines, and the implementation of quality control strategies (Graham, McCoy & Schultz, 2015). In Egypt, despite the availability of CPR guidelines and extensive training courses, the outcome of CPR in some hospitals is poor (Amer, Abdel Rahman, Aly & Ahmad, 2014) and the survival to discharge rate is low (Taha, Bakhom, Kasem & Fahim, 2015). The American Heart Association (AHA) 2015 guidelines emphasized the importance of providing high quality CPR that includes performing chest compressions at appropriate rate and depth, allowing full chest recoil, minimizing chest compression interruptions, and preventing excessive ventilation. High quality CPR increases the possibility of survival from cardiac arrest (Abella, 2016; AHA, 2015; Meaney et al., 2013). According to the British Medical Association & the Royal College of Nursing (2016), CPR should be performed competently and in harmony with updated clinical guidelines.

The quality of delivered CPR depends greatly on the education and skills of the resuscitation team (Chang et al., 2015; Graham et al., 2015). Nurses are integral part of the resuscitation team (Daniele, 2012). Emergency nurses play a vital role in recognizing and managing patients who experience cardiac arrest. They are usually the first witness and responders to cardiac arrested patients who arrive to the emergency department (Heng, Fong, Wee & Anantharaman, 2011). They participate in providing basic and advanced life support before transferring the patient to the intensive care unit for advanced treatment and post-arrest care (Graham et al., 2015). Therefore, emergency nurses should be familiar with CPR guidelines and should have psychomotor skills required for providing high quality resuscitation care (AHA, 2015). A study was conducted by Taha et al., (2015) to investigate different variables affecting return of spontaneous circulation (ROSC) and survival to discharge after cardiac arrest in three hospitals affiliated to Cairo University in Egypt. The study reported that in 95.8% of arrested patients, nurses did not have the confidence to initiate CPR, and called the incharge physician to perform CPR.

The investigators related this finding to nurses' lack of CPR knowledge and training. Furthermore, three studies investigated nurses' performance of CPR in different settings in different Egyptian hospitals (Abd Elnaeem, Mohamed, Mohammed & Abd El-

Aziz 2016; El-Meanawi, 2015; Refaey, 2012). These studies reported poor nurses' performance of CPR, and recommended continuous CPR training programs for nurses and periodic evaluation of nurses' performance. There is little evidence regarding the current level of emergency nurses' practice of CPR in emergency department in Egyptian hospitals. Therefore, this study focuses on this area. The results of this investigation can guide future planning of CPR training programs for emergency nurses in Egypt to enhance the quality of resuscitation care.

Aim of the Study

The aim of this study was to evaluate emergency nurses' performance of CPR in emergency department of an Egyptian hospital.

Research Question

What is the current level of nurses' performance of CPR in emergency department?

Method

Design

This study has an observational descriptive design.

Setting

The study was conducted in the emergency department of an Egyptian hospital. In this department, two rooms are allocated for providing emergency care for life-threatening conditions and cardiac arrested patients. These rooms are well equipped with technology and resources required for emergency care. The emergency team assigned for these two rooms includes doctors and nurses who are responsible for performing CPR for cardiac arrested patients. Data were collected from these two rooms. The emergency department has three hot days for receiving patients who need emergency care.

Sample

A total of 103 registered emergency nurses are working in the emergency department. Only forty one are involved in performing CPR procedure. Of them, 4 nurses were included in the pilot study, and were excluded from the study sample. Thirty seven nurses were recruited in the study (Figure 1).

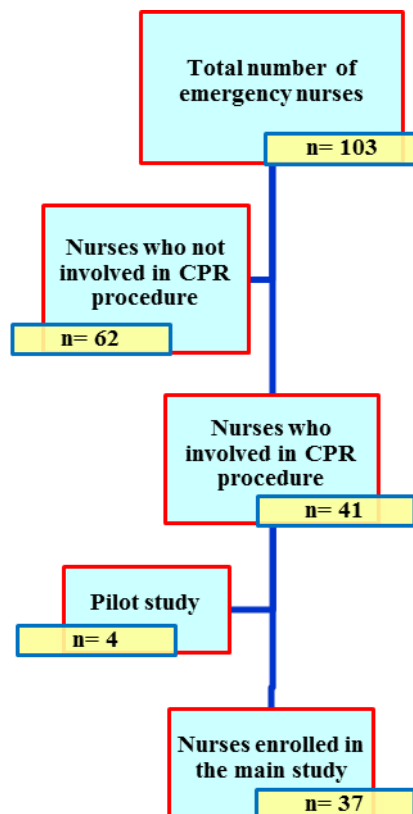


Fig 1: Flow chart for study participants

Ethical and Legal Issues

The study was approved by the local Research Ethics Committee. Nurses working in the two emergency rooms were informed about the details of the study. They were assured about the voluntariness nature of participation. They were also informed about how their personal information would be kept confidential and would not be linked directly to the published results. Then, they were invited to participate in this investigation. Informed consent was obtained from eligible nurses who accepted to take part in the study. The collected data were accessible only to the investigators and were safely stored electronically.

Data Collection Instrument

Data were collected using 'Emergency nurses' performance of CPR observation checklist'. This instrument comprised of two parts. Part one collected nurses' demographic characteristics such as age, gender, qualification, years of work experience and attended CPR courses/workshops. It was developed by the first investigator based upon relevant literature. Part two of the tool encompasses 5 caring domains: 'assessment', 'preparation', 'implementation', 'post care' and 'documentation'. Interventions under the first four domains were adopted from the European Resuscitation Council Guidelines for Resuscitation (ERCGR) 2015 (Perkins et al., 2015; Soar et al., 2015). These guidelines are already applied in the study setting. Some items of the guidelines were excluded as they were not applicable to the study setting. The 'documentation' domain was developed based upon relevant literature (Jacobs et al., 2004). The tool was checked for its content validity by 5 experts from critical care and emergency nursing, and medicine fields. The assessment domain comprises 4 steps. The preparation domain includes 13 steps. The implementation domain encompasses 24 steps. The post care domain involves 4 steps and the documentation domain consists of 5 steps. Internal consistency for the items of the CPR five domains was high with Cronbach's alpha coefficient ≥ 0.7 for each domain.

Data Collection Process

Data were collected by the primary investigator between July and December 2016. During this period, the study setting was screened in hot days for new emergency admissions that needed CPR. Nurses' personal background information was collected once using part 1 of the tool. Each nurse was observed during performing CPR twice in two different days using the observation checklist (part two of the tool). Patients' records were also checked after CPR for nurses' documentation. The observation was conducted by the first investigator who was non-participant observer of CPR procedure. Seventy four observations were collected from emergency nurses. Data collection focused on nurses' performance rather than patients' outcomes.

Data Analysis

Data were statistically analyzed using SPSS software version 25.0. Qualitative data were presented as frequency and percent. Quantitative data were expressed as median and interquartile range (IQR). Qualitative data were compared by Chi-Square test. To compare the probability of occurrence of categories of a nominal variable, One-Sample Chi-Square test was used. The non-parametric alternative Mann-Whitney U-test was used to compare quantitative data between more than two categories. Results were considered as statistically significant if p value is ≤ 0.05 .

Results

Table 1 presents the demographic profile of emergency nurses. The majority (73%) were less than 30 years old with high statistical significance difference ($p = 0.005$). Nearly half of the nurses attended CPR courses/workshops. The results showed no significant differences between nurses regarding the gender, qualifications, years of work experience or attended CPR courses/workshops.

Table 1: Demographic Profile of Emergency Nurses

Nurses' characteristics	n = 37		Significance test	
	Frequency	%	χ^2	P
Age (in years):				
• > 30	27	73	7.811	0.005
• ≤ 30	10	27		
Gender:				
• Male	17	45.9	0.234	0.622
• Female	20	54.1		
Qualification:				
• Bachelor of nursing	15	40.5	3.459	0.177
• Technical nursing institute	15	40.5		
• Secondary nursing school	7	18.9		
Years of work experience in emergency department:				
• > 5	17	45.9	3.297	0.192
• 5 – 10	12	32.4		
• ≤ 10	8	21.6		
Attended CPR courses/workshops:				
• Yes	19	51.4	0.027	0.869
• No	18	48.6		

P value is presented by one-sample chi-square test

P value ≤ 0.05

Nurses' performance of assessment for arrested patients is presented in table 2. The majority of nurses were competent in ensuring their own safety during procedure (78.4%). However, they were incompetent in performing other assessment steps: patient's response (62.2%), the signs of life (67.6%) and patient's ABCDE approach (83.8%). Significant differences were noted regarding nurses' performance of assessment except for checking patient's response.

Table 2: Emergency Nurses' Performance of Assessment during CPR

Assessment steps	Nurses' performance (n= 37)			Significance test	
	Competent	Incompetent	Not done	χ^2	P
Ensure personal safety (protective clothes)	29 (78.4)	8 (21.6)	-	11.92	0.001
Check the patient for response (shake & shout)	14 (37.8)	23 (62.2)	-	2.19	0.139
Check the patient for signs of life	12 (32.4)	25 (67.6)	-	4.57	0.033
Assess the patient's ABCDE	6 (16.2)	31 (83.8)	-	16.89	<0.0005

A: Airway B: Breathing C: Circulation D: Disability E: Expose P value ≤ 0.05

Table 3 depicts nurses' preparation for performing CPR for arrested patients. All nurses demonstrated competence in connecting patients to O2 therapy and pulse oximeter, and bringing the crash cart to the bed on a timely manner. The vast majority of nurses were competent in carrying out most steps of patient's preparation for CPR. However, more than half of the nurses were incompetent in checking patients' breathing and circulation (51.4%), opening airway (62.2%), removing visible objects from patients' mouth (54.1%) and assessing patients' cardiac rhythm (67.6%). Significant differences were detected in nurses' preparation for CPR except for checking patients' breathing and circulation.

Table 3: Emergency Nurses' Preparation for CPR

Preparation steps	Nurses' performance (n= 37)			Significance test	
	Competent	Incompetent	Not done	χ^2	P
If the patient respond					
Connect the patient to O2 therapy and pulse oximeter.	37 (100)	0 (0.0)	0 (0.0)	-	-
Attach the patient to cardiac monitor.	36 (97.3)	0 (0.0)	1 (2.7)	33.11	<0.0005
Obtain venous access.	36 (97.3)	0 (0.0)	1 (2.7)	33.11	<0.0005
If the patient does not respond					
Check the patient's breathing & circulation (not breathing or gasps)	18 (48.6)	19 (51.4)	0 (0.0)	0.027	0.869
Call for help	31 (83.8)	0 (0.0)	6 (16.2)	16.89	<0.0005
Attach the patient to cardiac monitor & O2 therapy	36 (97.3)	0 (0.0)	1 (2.7)	33.11	<0.0005
Turn the patient on to his back	35 (94.6)	1 (2.7)	1 (2.7)	62.49	<0.0005
Put a backboard under the patient.	10 (27.0)	0 (0.0)	27 (73.0)	7.81	0.005
Open airway using head tilt-chin-lift or jaw thrust	13 (35.1)	23 (62.2)	1 (2.7)	19.68	<0.0005
Remove any visible object or vomit from the patient's mouth using suction	15 (40.5)	20 (54.1)	2 (5.4)	14.00	0.001
Bring the crash cart to the bed with all needed equipment.	37 (100)	0 (0.0)	0 (0.0)	-	-
Assess the patient's cardiac rhythm (shockable or non-shockable)	10 (27.0)	25 (67.6)	2 (5.4)	22.11	<0.0005
Expose the patient's chest	30 (81.1)	2 (5.4)	5 (13.5)	38.32	<0.0005

SBAR: Situation, Background, Assessment, Recommendation technique; RSVP: Reason, Story, Vital signs & Plan communication tool; χ^2 : Chi-square; P value ≤ 0.05

Table 4 summarizes nurses' implementation of CPR steps for arrested patients. The results illustrated that all nurses were competent in resuming chest compressions after the delivery of the shocks and continuing of CPR in absence of pulse. However they were incompetent in assessing patients' ROSC. The majority of nurses were incompetent in performing chest compressions in appropriate depth (83.8), rechecking patients' cardiac rhythm 2 minutes post CPR (91.9%), calculating the appropriate time for adrenaline administration (81.1%) and repeating the steps for shockable rhythm if needed (91.9%). Also, most nurses (73%) did not put the backboard under the patient before performing chest compressions. There were significant differences in performance of most steps of CPR among nurses.

Table 4: Emergency Nurses' Implementation of Cardiopulmonary Resuscitation

Implementation steps	Nurses' performance (n= 37)			Significance test	
	Competent	Incompetent	Not done	χ^2	P
Start CPR 30 compressions : 2 breaths					
Locate hands in center of chest, with one hand on the top of the other hand.	13 (35.1)	24 (64.9)	0 (0.0)	3.27	0.071
Perform 30 chest compressions at rate of 100/minute or more, with depth of at least 2 inches while applying D/C leads and adjust the joules.	5 (13.5)	31 (83.8)	1 (2.7)	43.027	<0.0005
Ventilate the patient using mask ambo-bag with 100% O2.	13 (35.1)	23 (62.2)	1 (2.7)	19.676	<0.0005
Stop chest compressions to confirm rhythm analysis.	7 (18.9)	2 (5.4)	28 (75.7)	30.565	<0.0005
Resume chest compressions immediately until the D/C charge is ready.	9 (24.3)	0 (0.0)	28 (75.7)	9.757	0.002
In case of shockable rhythm					
Warn the resuscitation team to stand clear and remove O ₂ therapy device, and when clear deliver the shock.	22 (59.5)	11 (29.7)	4 (10.8)	13.351	0.001
Continue CPR using a ratio of 30:2 starting with chest compressions for 2 minutes.	33 (89.2)	4 (10.8)	0 (0.0)	22.730	<0.0005
Recheck the rhythm if persists shockable, repeat steps 9 -14 and deliver the second shock .	2 (5.4)	34 (91.9)	1 (2.7)	57.135	<0.0005
Administer 1 mg of adrenaline through IV route every 3-5 minutes.	7 (18.9)	30 (81.1)	0 (0.0)	14.297	<0.0005
If persists shockable, repeat steps 9 -14 and deliver the third shock.	3 (8.1)	34 (91.9)	0 (0.0)	25.973	<0.0005
Recommence chest compressions immediately.	37 (100)	0 (0.0)	0 (0.0)	-	-
Administer 1mg of adrenaline through IV route every 3-5 minutes, 300 mg of amiodarone IV during further 2 minutes of CPR.	2 (5.4)	25 (67.6)	10 (27.0)	22.108	<0.0005
Continue 2-minutes of CPR – Then check the rhythm - D/C sequence if persists shockable.	35 (94.6)	2 (5.4)	0 (0.0)	29.432	<0.0005
In case of non-shockable rhythm					
Start CPR 30 compressions: 2 breaths.	24 (64.9)	13 (35.1)	0 (0.0)	3.27	0.071
Administer adrenaline 1mg IV as soon IV access is achieved.	35 (94.6)	1 (2.7)	1 (2.7)	62.486	<0.0005
Continue CPR using a ratio of 30:2 until the airway is secured (ETT).	36 (97.3)	1 (2.7)	0 (0.0)	33.108	<0.0005
Recheck the rhythm after 2 minutes, if organized electrical activity is seen, check pulse and ROSC.	2 (5.4)	34 (91.9)	1 (2.7)	57.135	<0.0005
If pulse and ROSC are present, start post resuscitation care.	0 (0.0)	37 (100)	0 (0.0)	-	-
If no, Continue CPR.	37 (100)	0 (0.0)	0 (0.0)	-	-
Recheck the rhythm after 2 minutes and proceed accordingly.	13 (35.1)	22 (64.9)	2 (5.4)	16.270	<0.0005
Administer further 1mg of adrenaline IV every 3-5 minutes	15 (40.5)	20 (54.1)	2 (5.4)	14.00	0.001
If the rhythm is changed to shockable follow its algorithm.	0 (0.0)	26 (70.3)	11 (29.7)	6.081	0.014
Check and correct the possible reversible causes (4 Hs and 4 Ts)	0 (0.0)	0 (0.0)	37 (100)	-	-
Discontinue CPR in the following cases; absent ROSC sings (no HR, pulse) or persistent asystole.	36 (97.3)	1 (2.7)	0 (0.0)	33.108	<0.0005

D/C: Defibrillator/Cardioversion; IV: Intravenous ; ROSC: Return of spontaneous circulation; ETT: Endotracheal Tube; 4Hs: Hypoxia, Hypovolemia, Hypothermia, & Hypokalemia/Hypokalemia; 4Ts: Tension pneumothorax, Tamponade, Toxins & Thrombosis (pulmonary/coronary); χ^2 : Chi-square; P value ≤ 0.05

Table 5 illustrates emergency nurses' performance of post CPR care and documentation. All nurses were competent in checking and counting the used medications, cleaning the crash cart and refilling the used items. Only 56.8% of them were competent in taking consideration according to patient's response to the CRP procedure. However 78.4% were incompetent in removing gloves and washing hands after procedure with a significant difference noted among nurses. Regarding documentation, all nurses were competent in documenting the medications used. However, the majority either provided incomplete documentation of patients' care or did not document the type of dysrhythmia the patients' experience, D/C attempts or the delivered joules. There were significant differences in most items of documentation among nurses.

Table 5: Emergency Nurses' Performance of Post Cardiopulmonary Resuscitation Care and Documentation

Post care & Documentation steps	Nurses' performance (n= 37)			Significance test	
	Competent	Incompetent	Not done	χ^2	P
Post care					
Take considerations according to patient's response to the CPR.	21 (56.8)	16 (43.2)	0 (0.0)	0.676	0.411
Check and count the medications used.	37 (100)	0 (0.0)	0 (0.0)	-	-
Clean the crash cart and refill the used items.	37 (100)	0 (0.0)	0 (0.0)	-	-
Remove gloves and wash hands.	8 (21.6)	29 (78.4)	0 (0.0)	11.919	0.001
Documentation					
Document the starting time and duration of CPR.	5 (13.5)	17 (46.0)	15 (40.5)	6.703	0.035
Document the type of dysrhythmia.	0 (0.0)	14 (37.8)	23 (62.2)	2.189	0.139
Document the attempts and amount of D/C joules used.	4 (10.8)	4 (10.8)	29 (78.4)	33.784	<0.0005
Document the medication used.	37 (100)	0 (0.0)	0 (0.0)	-	-
Document patient's response and outcome.	9 (24.3)	27 (73.0)	1 (2.7)	28.757	<0.0005

χ^2 : Chi-square

P value ≤ 0.05

Table 6 compares emergency nurses' performance of CPR in relation to their demographic characteristics. The results showed that nurses who were 30 years old or above were more competent than other nurses. Also, Bachelor degree nurses were more competent in performing CPR than graduates of technical institutes and secondary nursing schools. Additionally, nurses who had 10 years or more of work experience in ICU demonstrated competent performance than other nurses. Male nurses had better performance than female nurses. No significant difference was noted between nurses' level of performance and their demographic characteristics. However, nurses who attended CPR courses/workshops were more competent than other nurses with a significant difference noted (0.027).

Table 6: Comparison between Total Mean Percent of Nurses' Performance of CPR and their Demographic Characteristics

Nurses' characteristics	Performance domains (n=37)				
	Assessment	Preparation	Implementation	Post care	Documentation
Age (years)					
• <30	50(50)	53.33(20)	37.5(25)	75(25)	20(0.0)
• ≥ 30	75(63)	66.67(36.67)	45.83(32.29)	75(50)	20(20)
Z value	-0.813	-0.721	-0.450	-1.029	-0.364
p value	0.416	0.471	0.653	0.304	0.716
Gender					
• Male	50(75)	60(33.33)	37.5(30.21)	75(50)	20(0.0)
• Female	50(50)	53.33(26.67)	29.17(25)	50(25)	20(20)
Z value	-0.982	-1.129	-1.696	-1.834	-0.953
p value	0.326	0.259	0.090	0.067	0.340
Qualification					
• Bachelor	100(100)	73.33(46)	54.17(50)	75(50)	20(60)
• Technical	50(75)	60(20)	29.17(25)	50(25)	20(0.0)

• Secondary Nursing School	50(25)	53.33(40)	37.5(16.67)	75(0.0)	20(0.0)
χ^2	0.679	0.772	1.896	3.164	1.874
<i>p</i> value	0.712	0.680	0.388	0.206	0.392
Years of work experience in emergency department					
• < 5	50(50)	53.33(26.67)	29.17(18.75)	50(25)	20(0.0)
• 5-10	50(63)	60(33.33)	56.25(46.88)	87.5(50)	20(20)
• ≥ 10	100(88)	80(43.33)	37.5(19.79)	75(0.0)	20(15)
χ^2	3.170	3.144	4.318	5.340	4.120
<i>p</i> value	0.205	0.208	0.115	0.069	0.127
Attended CPR courses					
• Yes	75(50)	66.67(33.33)	41.67(37.5)	75(50)	20(20)
• No	50(44)	53.33(18.33)	35.42(12.5)	50(25)	20(0.0)
Z value	-1.895	-2.205	-1.891	-1.698	-1.780
<i>p</i> value	0.058	0.027	0.059	0.090	0.075

Z value: Mann-Whitney Test; χ^2 : Chi-square (Kruskal-Wallis Test); *P* value ≤ 0.05

Discussion

This study provided a rounded picture of nurses' performance of CPR in emergency department. The results showed that the majority of nurses were competent in performing some of the CPR steps such as safeguarding their own safety during procedure, connecting the patient to cardiac monitor, pulse oximeter and O₂ therapy, calling for help, managing the crash cart, turning the patient on his back and exposing his/her chest. It was evident that nurses were skilled in handling machines and equipment (e.g. monitors, crash cart & O₂). However, most nurses were incompetence in assessing arrested patients' response, signs of life, ABCDE approach and cardiac rhythm, and opening patient's airway. These are basic skills in determining whether the patient is experiencing cardiac arrest (AHA, 2015). Early recognition of cardiac arrest is the first step in the chain of survival (Perkins et al., 2015), and a vital step in prompt management (Sayre et al., 2010). If nurses are lacking in these skills, they may not be able to recognize that the patient is in cardiac arrest. This can delay management and affect patient's survival. Failure to recognize arrest is considered one of the common pitfalls of CPR (Strzyzewski, 2006). According to the ERCGR 2015 section 2, health care providers should be capable of recognizing cardiac arrest, calling for help and commencing CPR, and it is expected that critical care and emergency staff are competent in performing advanced CPR than other hospital staff (Perkins et al., 2015).

Most nurses demonstrated lacking skills in locating hands in the center of chest and performing chest compressions, ventilating the patient using ambo-bag-mask, and re-checking cardiac rhythm. We found these findings striking considering the fact that nearly half of the nurses had clinical work experience of more than 5 years and reported attending CPR courses/workshops. Unfortunately, our data did not address the number or duration of the training courses that emergency nurses attended. Our findings are in congruence with published research which addressed this area in Egypt, and reported nurses' poor knowledge and skills concerning CPR (Abd Elnaeem et al., 2016; El-Meanawi, 2015; Refaey, 2012). Survival from cardiac arrest depends greatly on the quality of delivered CPR (Abella, 2016). Proper hand placement on the mid-sternum, effective chest compressions and effective ventilation are important resuscitations skills nurses must possess (Strzyzewski, 2006). Recent evidence suggests that 100–120 cardiac compressions/minute may enhance the ROSC in cardiac arrested patients (Kilgannon et al., 2017) and increase the survival rate (Idris et al., 2015). In the current study, most nurses did not put a backboard underneath the patient before initiating CPR. For optimal delivery of effective cardiac compressions, the arrested patient must be positioned on a firm surface during CPR (Perkins et al., 2015). It was emphasized that the quality of the delivered chest compressions is a key element for successful CPR (Abella et al., 2005).

During CPR, the ambo-bag-mask is used to deliver two breaths after every 30 chest compressions. Resuscitation guidelines emphasized the effectiveness of a compression to ventilation ratio of 30:2 in improving arrested patient outcome (AHA, 2015; Perkins et al., 2015). During cardiac arrest, effective chest compressions lead to circulating of oxygenated blood to the brain. If insufficient ventilation is delivered, the brain will not receive enough oxygenated blood no matter how effective the chest compressions are (Strzyzewski, 2006). Hence, failure of the nurse to deliver effective ventilation/oxygenation to the arrested patient can result in unsuccessful CPR and poor neurological outcome. The results illustrated that all nurses were competent in checking and recording the medication administered during CPR, and sorting out the crash cart after procedure. However the majority did not comply with the standard precautions related to hand washing and gloving. In the same sense, Chiang et al., (2008) evaluation of health care providers' compliance with standard precautions during CPR in the emergency department showed that nursing staff had the lowest compliance ranking score. Similarly, Haac et al., (2017) investigated health care providers' compliance with hand hygiene in trauma resuscitation setting. The results of their investigation indicated care providers' poor compliance with hand hygiene (0-15%), and the use of gloves before (69%) and after contacting the patients, (47%) and after dealing with body fluid (58%). In 2009, the World Health Organization (WHO) provided extensive guidelines on hand hygiene in health care. These guidelines emphasized the importance of compliance with '5 moments of hand washing' in hospital setting: 'before touching a patient', 'before a procedure', 'after contacting with body fluids', 'after touching a patient' and 'after touching patient surroundings'. Applying the WHO's hand hygiene strategy during CPR procedure could be difficult considering the fact that the patient is arrested and each minute is valuable in saving his/her life. Hence, nurses' priority during

CPR is patient's life rather than safety and infection control. The findings illustrated that nurses did comply with guidelines regarding the time of adrenaline administration. Adrenaline has been recommended in all CPR guidelines as it increases myocardial coronary and cerebral blood flow. According to the ERCGR 2015 section 3, after obtaining IV access, during the next two minutes of CPR, 1 mg of adrenaline is administered through IV route (Soar et al., 2015). If there is no pulse or ROSC, 1 mg of IV adrenaline is given at 3-5 minute intervals. Donnino et al., (2014) carried out a large scale study to investigate whether there is an association between early adrenaline administration and ROSC, survival and good neurological outcome in cardiac arrests with non-shockable rhythm. The study found positive association between early adrenaline administration, and patients' survival and neurological outcome. Hence, emergency nurses should be aware of the recommended dose and timing of adrenaline during CPR to enhance patient outcome.

The results showed lack of documentation of important aspects of patient care during CPR such as the time and duration of CPR, D/C attempts and joules, and patient's response to intervention. Similarly, Allan, Bell and Pittard (2011) reported poor documentation of resuscitation attempts, and deficit documentation of involved health care providers, important observations and interventions, the number of cycles and shocks provided in medical records. Additionally, the overall timing of the resuscitation was noted in only 48% of the arrested patients. The authors related these findings to the absence of national CPR documentation guidelines and lack of staff's training. Documentation is an integral part of nurses' duties. It communicates information to health care team and provides legal protection (Weizberg et al., 2011). Most importantly, it provides evidence that appropriate care is provided to arrested patient, and ensures continuity of care. Hence, there is a need for standardized documentation system for cardiac arrests. Additionally, it is important to enhance emergency nurses' documentation skills through education and training programs. Our findings illustrated that better performance of CPR was noted among older and more experienced nurses. Also, male nurses were more competent in performing CPR than female nurses. One reason could be the body build and muscle strength of males which enable them to perform cardiac compressions and nursing procedures easily and effectively. Nurses with Bachelor degree in nursing had better performance of CPR than other nurses. This is expected because in Bachelor nursing program, nursing students are taught basic life support in level 1, advanced life support in level 2 and different types of cardiac dysrhythmias in level four. Nurses who attended CPR courses were more competent than those who did not attend any educational courses. Our results build on those of other investigations (Elazazay, Abdelazez and Elsaie, 2012; Gilfoyle et al., 2017; Refaey 2012; Taha et al., 2015) that emphasized the importance of nurses' education and training for the quality of CPR performance. The training programs must be based upon current accepted guidelines and appropriate for nurses' clinical area and role (Hamilton, 2005). Evidence suggests that resuscitation skills can decline after 6 months of the training (Cooper, Johnston & Priscott, 2007). Therefore, refreshers CPR trainings are also recommended to maintain nurses' CPR competency (Roshana, Batajoo, Piryani & Sharma, 2012).

Conclusion and Recommendations

The majority of nurses were incompetent in performing most of CPR steps. This can affect the quality of CPR delivered to arrested patients, and consequently their survival. All emergency nurses should be certified with basic and advanced life support. They should be familiar with the CPR guidelines adopted in the hospital. They should also attend in-service continuous CPR courses and workshops. Nurses' performance of CPR should be periodically evaluated. We believe that emergency nurses' performance of CPR, attended courses and CPR certification should be linked directly to their annual increment and promotion. Our results highlighted the need for future studies to investigate the impact of emergency nurses' resuscitation skills on patient outcomes.

Limitations

Our study has three limitations. First, this research was carried out in one emergency department located in one city in Egypt; therefore, the results cannot be generalized to all emergency nurses in Egypt. Second, the data collection tool did not address the type or duration of training courses/programs that emergency nurses attended, so it difficult to make conclusion about the effectiveness of these programs. Third, data collection was mainly based upon observation of nurses' performance of CPR which may lead to some unavoidable bias.

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