Assessment of Iranian Nurses and Emergency Medical Personnel in Terms of Cardiopulmonary Resuscitation Knowledge Based on the 2010 Guideline

Abstract

Background: The aim of this study was to compare the cardiopulmonary resuscitation (CPR) knowledge of hospital nurses and emergency medical personnel in Kermanshah, Iran. Materials and Methods: This descriptive cross-sectional study was conducted on 330 hospital nurses and 159 emergency medical personnel working in educational hospitals and emergency medical centers in Kermanshah. Data were collected using a validated and reliable (r = 0.74) researcher-made questionnaire consisting of a demographic characteristics questionnaire and the 2010 CPR knowledge questionnaire. Results: Based on the most recent CPR guidelines, the knowledge of 19.5%, 78.6%, and 1.9% of the emergency medical staff was excellent, good, and moderate, respectively. None of the participants had poor knowledge. In addition, the knowledge of 20.2%, 65.4%, 14%, and 0.4% of the nurses in this study was excellent, good, moderate, and poor, respectively. There was no significant difference in CPR knowledge between hospital nurses and emergency medical staff. Moreover, no significant association was found between CPR knowledge and gender, age, work experience, field of study, previous occupation, and advanced resuscitation courses. However, CPR knowledge of individuals with training in basic CPR courses was higher than participants without training in these courses (P < 0.05). Conclusions: Based on the findings of this study, CPR knowledge among Iranian nurses and emergency medical personnel was in an acceptable range. Nevertheless, it is strongly recommended that nurses and emergency staff receive training according to the most recent CPR guidelines.

Keywords: Cardiopulmonary resuscitation, emergency medical technicians, Iran, knowledge, nurses

Introduction

Advanced and up-to-date knowledge of cardiopulmonary resuscitation (CPR) is essential for all health care personnel. This subject has gained increasing attention and has been promoted over recent years.[1] The most recent CPR guidelines have focused on the use of automated external defibrillators (AED), firm and rapid pressure on the chest with a frequency of 100 times per minute at the beginning of the CPR, and ratio of heart massage to pulmonary ventilation during CPR of 30:2 in all age groups.[2] In all age groups, pulmonary ventilation should be given for 1 second to avoid hyperventilation. In addition, only 1 shock in electroconvulsive therapy followed immediately for 2 minutes by chest massage and ventilation has been recommended. In the new guidelines for CPR, the use of a pacemaker for fibrillation is not recommended, whereas the use of resuscitation and medication is emphasized.[3] Epinephrine and vasopressin are the most important drugs used for CPR.[3] Intraosseous routes are preferred in patients with inaccessible veins.[2] After resuscitation, the use of induced hypothermia is recommended.[1]

It is essential that the nursing education system instructs nurses on these principles and their correct application.[4] Previous studies have reported that these training programs can affect the basic knowledge of nurses on CPR.[5] Preusch et al. reported that, based on the 2005 guidelines for CPR, nurses’ knowledge on CPR is low.[5] In addition, Passali et al. reported that the level of awareness regarding Basic Life Support (BLS) and Advanced Life Support (ALS) principles among nurses and doctors of Greece is not sufficient.[7] It has also been reported that emergency medicine staff have poor knowledge of resuscitation protocols,[8] however, they have the

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adequate skills to embed aggressive air routes in advanced resuscitation.[9] Furthermore, a delay in the administration of emergency drugs due to poor knowledge of the staff on medication was reported in some studies.[10] Observance of important practicable points that have been indicated in the most recent resuscitation guidelines can increase the number of successful resuscitation cases. Moreover, it is necessary that all individuals who perform CPR use these suggestions and recommendations in one way; the way they were taught, observed, and performed in the clinical environment. Furthermore, the most important elements of training require assessment for the improvement of postgraduate teaching programs. To our knowledge, no similar study has been performed in the Kermanshah University of Medical Sciences, Kermanshah, Iran, until today. Thus, this survey was conducted with the main goal of determining the level of awareness of the nursing staff and emergency medical technicians of Kermanshah regarding the 2010 resuscitation guidelines.

The principles listed in the most recent resuscitation guidelines can increase the success of the resuscitation process. Given the importance of the latest CPR knowledge for all health care personnel, especially the emergency medical staff, and retraining programs, the aim of this study was to compare CPR knowledge between hospital nurses and emergency medical staff in Kermanshah.

Materials and Methods

Design and participants

This descriptive cross-sectional study was performed in the Nursing Society of Kermanshah. Based on the pilot study with a confidence interval (CI) of 95% and power of 90%, the sample size was estimated as 330 individuals. The participants were selected through simple random sampling from the list of nurses of every hospital and among 159 emergency medical staff working in the emergency medical centers in Kermanshah during September 2012 to May 2013. The participants were divided into 4 groups. Sampling was performed by the researcher, and the selected participants filled the questionnaire voluntarily. The emergency medical personnel were categorized according to the location; 18.2% from headquarter centers, 71.7% from urban centers, and 10.1% from road centers.

Data collection and tools assessment

Data on demographic characteristics and CPR knowledge of the participants was collected using a validated and reliable \( (r = 0.74) \) questionnaire that was used by the researcher in a previous study.[11] This questionnaire contains 40 questions on CPR knowledge [Table 1]; the questionnaire includes the basic rules of initiation and termination of CPR, principles of establishing artificial ventilation and airway management, principles of external chest compressions and massage, and fundamentals of advanced resuscitation. To determine the validity of this questionnaire, the questionnaire was distributed among 25 faculty members to obtain their feedback. A pilot study was conducted to determine the reliability of the questionnaire. In this pilot study, a Cronbach’s alpha coefficient of 90% and Pearson’s correlation coefficient of 0.74 were obtained. The total score of knowledge for each staff was measured, which varied from 0 to 40, which was then categorized as excellent (31 to 40), good (21 to 30), moderate (11 to 20), and poor (less than 10).

Statistical analysis

Data were presented as average and standard deviation (SD) and percentage. For quantitative and qualitative data analysis, two-dimensional tables in number and percentage form were used. For the investigation of the equality of variance of the three groups, analysis of variance (ANOVA) was used. One-way ANOVA, Spearman’s correlation, and Chi-square were used for comparison of the scores in all the groups. All \( P \) values of less than 0.05 were regarded as significant. All statistical analyses were conducted using STATA software (version 11, StataCorp, College Station, TX, USA).

Ethical considerations

Ethical approval was obtained from the Faculty of Nursing and Midwifery, Kermanshah University of Medical Sciences, Kermanshah, Iran, before conducting the study with code number of 91015. Written informed consents were obtained from all participants.

Results

The knowledge of 19.5%, 78.6%, and 1.9% of emergency medical staff was excellent, good, and moderate, respectively. None of the participants obtained a poor score. In addition, the knowledge of 20.2%, 65.4%, 14%, and 0.4% of the nurses in this study was excellent, good, moderate, and poor, respectively. No significant difference was observed between the two groups in CPR knowledge \( (P > 0.2) \). The distribution of educational levels among emergency medical staff was as follows: Nurse’s aides = 35.8%, emergency medical technicians = 36.5%, bachelor degree = 20.8%, and discontinuous bachelor degree = 6.9%. The mentioned distribution among nurses was as follows: Nursing technicians = 6.5%, bachelor degree = 86.6%, discontinuous bachelor degree = 4%, and graduate degree = 2.8%. In nurses, there was no statistically significant difference between awareness level of men and women. Although the average distinction of awareness level among subjects with master’s degree was higher than other degrees, this finding was not statistically significant [Table 2].

In emergency medical staff, a significant inverse association was found between age and CPR knowledge, meaning older staff had less CPR knowledge compared with younger staff \( (r = -0.09) \) \( (P = 0.009) \). No significant
The time necessary for determination of the existence of a pulse in the patient is 10 seconds.

In an unwitnessed cardiac arrest, first, cardiac massage and respiratory ventilation must be performed for 2 complete minutes.

When there is only one rescuer, mouth-to-mouth or mouth-to-mask artificial respiration is more effective than ventilation using bag valve mask.

Capnography is the most reliable way of assurance of placement of the endotracheal tube in the windpipe.

There is no need for a laryngoscope for the preparation of laryngeal mask embedding and combitube.

The longest permitted duration of cardiac massage cessation for placement of endotracheal tube is 10 seconds.

At the time of placement control of endotracheal tube in the windpipe, cardiac massage must be stopped.

According to the neurologic state of the patient (decreased level of consciousness/limbs paralysis), CPR can be stopped.

Questions about airway management
8. Before starting artificial ventilation, opening of the airway is necessary
9. The first ventilation in CPR consists of two repeated respirations to the patient
10. In CPR performed in the hospital using oxygen, the use of a high percentage is necessary
11. The chest must come up clearly with every artificial respiration
12. At the beginning of CPR, hyperventilation is necessary
13. Length of time for artificial respiration is 1 second in all age groups
14. When there is only one rescuer, mouth-to-mouth or mouth-to-mask artificial respiration is more effective than ventilation using bag valve mask.

Questions about external cardiac massage
19. In an unwitnessed cardiac arrest, first, cardiac massage and respiratory ventilation must be performed for 2 complete minutes.
20. After 2 minutes of complete cardiac massage and respiratory ventilation, the patient’s pulse must be controlled for the first time.
21. The time necessary for determination of the existence of a pulse in the patient is 10 seconds.
22. In the first minute of witnessed cardiac arrest, cardiac massage is more important than respiratory ventilation.
23. Cardiac massage must be performed rapidly and with force.
24. The least number of times of cardiac massage are 100 times per minute in all ages (except infants).
25. Ratio of cardiac massage to respiration in all ages for usual rescuers is 30:2.
26. Ratio of cardiac massage to respiration in hospitals is 3:1 in infants.
27. Ratio of cardiac massage to respiration in children by 2 professional rescuers is 15:2.
28. An adult’s chest must be pressed to the extent of 4–5 centimeters in every massage.
29. For every massage, the heel of the hand of the rescuer must be placed in the middle of chest and between the lines that attach the head of the chest.
30. After every massage, the chest must be permitted to completely return to its initial place.

Questions about advanced CPR
31. In the case of ventricular fibrillation, shock must be given 3 times.
32. Outside the hospital, before using automatic electroshock, CPR must be performed for 2 complete minutes.
33. If the rescuer does not know the energy extent for finishing ventricular fibrillation, 200 J must be selected in biphasic machine and 360 J in monophasic machine.
34. If the patient’s pulse does not return after electroshock unloading, CPR must be continued for 2 minutes.
35. In the case of asystole, skin pacemaker must be used.
36. After failure of treatment with epinephrine and defibrillation medicine, vasopressin can be used.
37. If venous puncture cannot be conducted on the patient, interosseous injection is recommended.
38. The first medicine for controlling ventricular dysrhythmias is amiodarone.
39. Dosage of interosseous injected medicine must be 2-2.5 times that of venous dose.
40. If CPR is successful in adults, induced hypothermia must be used.

CPR: Cardiopulmonary resuscitation

Table 1: Characteristics of Questionnaire; question based on samples answers

| No | Questions about the legal aspects of CPR | Right answer (%) |
|----|-----------------------------------------|------------------|
| 1  | If the patient requires CPR, we must wait for the doctor as the leader of the resuscitation team | 85.7 |
| 2  | Midrise double is a criterion for not starting CPR | 20.0 |
| 3  | CPR must be left to the specialist until returning of vital signs or assurance of certain death of the patient | 95.5 |
| 4  | In the case that the patient’s family requests it, CPR can be stopped | 25.0 |
| 5  | If the rescuer’s life is in danger, CPR can be stopped | 51.1 |
| 6  | CPR on frozen bodies, neck wounds, peripheral cyanosis, and circumstances in which there is no hope for improving the patient is not necessary | 66.3 |
| 7  | According to the neurologic state of the patient (decreased level of consciousness/limbs paralysis), CPR can be stopped | 7.0 |
| 8  | Before starting artificial ventilation, opening of the airway is necessary | 93.1 |
| 9  | The first ventilation in CPR consists of two repeated respirations to the patient | 75.5 |
| 10 | In CPR performed in the hospital using oxygen, the use of a high percentage is necessary | 60.2 |
| 11 | The chest must come up clearly with every artificial respiration | 86.0 |
| 12 | At the beginning of CPR, hyperventilation is necessary | 30.0 |
| 13 | Length of time for artificial respiration is 1 second in all age groups | 36.8 |
| 14 | When there is only one rescuer, mouth-to-mouth or mouth-to-mask artificial respiration is more effective than ventilation using bag valve mask. | 40.0 |
| 15 | Capnography is the most reliable way of assurance of placement of the endotracheal tube in the windpipe. | 45.7 |
| 16 | There is no need for a laryngoscope for the preparation of laryngeal mask embedding and combitube | 43.0 |
| 17 | The longest permitted duration of cardiac massage cessation for placement of endotracheal tube is 10 seconds. | 66.0 |
| 18 | At the time of placement control of endotracheal tube in the windpipe, cardiac massage must be stopped | 38.6 |

Questions about external cardiac massage
19. In an unwitnessed cardiac arrest, first, cardiac massage and respiratory ventilation must be performed for 2 complete minutes.
20. After 2 minutes of complete cardiac massage and respiratory ventilation, the patient’s pulse must be controlled for the first time.
21. The time necessary for determination of the existence of a pulse in the patient is 10 seconds.
22. In the first minute of witnessed cardiac arrest, cardiac massage is more important than respiratory ventilation.
23. Cardiac massage must be performed rapidly and with force.
24. The least number of times of cardiac massage are 100 times per minute in all ages (except infants).
25. Ratio of cardiac massage to respiration in all ages for usual rescuers is 30:2.
26. Ratio of cardiac massage to respiration in hospitals is 3:1 in infants.
27. Ratio of cardiac massage to respiration in children by 2 professional rescuers is 15:2.
28. An adult’s chest must be pressed to the extent of 4–5 centimeters in every massage.
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36. After failure of treatment with epinephrine and defibrillation medicine, vasopressin can be used.
37. If venous puncture cannot be conducted on the patient, interosseous injection is recommended.
38. The first medicine for controlling ventricular dysrhythmias is amiodarone.
39. Dosage of interosseous injected medicine must be 2-2.5 times that of venous dose.
40. If CPR is successful in adults, induced hypothermia must be used.

CPR: Cardiopulmonary resuscitation
relationship was observed between age and CPR knowledge in hospital nurses ($P = 0.75$). In addition, gender (men: $P > 0.6$) (women: $P > 0.3$) and work experience ($P > 0.85$) had no significant association with CPR knowledge among emergency medical staff or hospital nurses.

Table 3 illustrates that CPR knowledge, based on the 2010 guidelines, was not different among emergency medical staff with different educational degrees ($P = 0.43$). However, nurse’s aids, in comparison to emergency staff and other educational degrees, had higher knowledge of airway management ($P = 0.036$). In addition, individuals with discontinuous bachelor degree had higher knowledge of advanced CPR performance than emergency personnel and other educational degrees ($P = 0.021$). No significant difference was found in CPR knowledge among hospital nurses with different educational degrees ($P = 0.39$).

Based on the most recent guidelines for CPR, the emergency staff in different locations did not have different CPR knowledge ($P = 0.65$). In addition, location-stratified analyses revealed a significant difference in CPR knowledge among nurses in different hospital wards ($P < 0.001$), so that their knowledge score in order of high to low was coronary care unit (CCU) nurses ($P < 0.001$), internal ward nurses ($P = 0.006$), special unit nurses ($P = 0.005$), and operating and emergency room nurses [Table 3].

In this study, 83.6% of emergency medical staff had passed CPR training courses. CPR knowledge including legal aspects of CPR ($P = 0.04$), airway management ($P = 0.02$), and advanced CPR ($P = 0.03$) according to the most recent guidelines was significantly higher in emergency staff who had passed basic CPR courses compared with those who had not ($P = 0.018$). Furthermore, total CPR knowledge score was higher in nurses who had passed basic CPR courses compared with those who had not passed these courses ($P = 0.01$) [Table 4].

### Discussion

In this study, level of awareness of the latest changes in resuscitation according to the 2010 guidelines of 20.2%, 65.4%, 14%, and 3% of nurses was perfect, good, moderate, and weak, respectively. This level among 19.5%, 78.6%, and 1.9% of emergency medical staff was excellent, good, moderate, and weak, respectively. One study in the USA showed that CPR knowledge and performance of 60 emergency medical technicians working in 31 urban stations was poor and moderate according to the latest CPR guidelines. Passali et al. reported that the knowledge of nurses and physicians in Greece on principles of ALS and BLS was not sufficient. A study conducted by Preusch et al. in Heidelberg University, Germany, showed a lack of CPR knowledge among nurses. This study reported that basic resuscitation training courses based on the new guidelines are required for nurses.

It has also been reported that, in Japan, most nurses are not aware of the latest CPR guidelines, and training courses on new CPR principles are needed. In Iran, one study indicated that the basic CPR knowledge of medical staff was insufficient. In China, the lack of CPR knowledge was reported in both clinical and health nurses. In a study in India, a severe lack of BLS knowledge was observed in 1054 nurses, physicians, and nursing students. In our study, there was no significant difference between emergency medical staff and hospital nurses in terms of CPR knowledge based on the latest guidelines. However, the electroconvulsive therapy (ECT) and AED knowledge of emergency medical staff was higher than nurses, although this difference was not significant. In line with our findings, Borimnejad et al. reported that work experience had no effect on CPR knowledge of nurses. However, in contrast with our findings, Mohsenpour et al. reported that nurses in Kerman, Iran, with high working experience had high CPR knowledge.

One of the most important findings of our study was that older emergency staff had lower CPR knowledge, which should be considered in training programs for the personnel.

Based on our findings, emergency personnel with a history of basic CPR training courses and independent CPR performance had higher CPR knowledge compared with those who had not passed these courses. Nevertheless, Borimnejad et al. reported that CPR training courses have no effect on the rate of personnel’s knowledge. Emphasis on CPR training programs and inattention to independent

### Table 2: Demographic characteristics of emergency medical staff and nurses

| Emergency medical staff | Mean (SD) or percentage | Nurses | Mean (SD) or percentage |
|-------------------------|-------------------------|--------|-------------------------|
| Women                   | 6.4%                    | Women  | 77.3%                   |
| Age                     | 30 (6.5)                | Age    | 32.7 (7.3)              |
| Nurse’s aides           | 35.8%                   | Nursing technicians | 6.5%       |
| Emergency medical technicians | 36.5%              | Bachelor’s degree | 86.7%     |
| Bachelor’s degree       | 20.8%                   | Discontinuous bachelor’s degree | 4%        |
| Discontinuous bachelor’s degree | 6.9%                | Graduate degree | 2.8%       |
| Work experience         | 8.5 (6.3)               | Work experience | 9.4 (8.2) |
| Basic CPR courses       | 83.6%                   | Basic CPR courses | 91.7%     |

SD: Standard deviation, CPR: Cardiopulmonary resuscitation.
In this study, the total score of CPR knowledge was not significantly different among nurses and emergency staff with different educational degrees. This finding was confirmed by Guyette et al. who assessed the knowledge of emergency medical personnel.[9]

Low CPR knowledge of nurses and emergency staff based on advanced CPR principles, as a finding of our study, was confirmed by other similar studies.[7] Inadequate skills to determine and diagnose the patients is the main reason for low knowledge of advanced CPR in nurses and newly graduated doctors.[17] Hence, it is necessary to incorporate advanced CPR principles in retraining programs for nurses and emergency personnel according to the 2010 guidelines. This suggestion was also presented in the study by Perkins et al. to increase advanced CPR quality.[18]

The knowledge of emergency medical staff on the use of ECT and AED was appropriate. This finding was in line with results of the study by Xanthos et al. who recommended BLS and AED retraining programs for nurses.[9] The CPR knowledge questionnaire regarding airway management illustrated that the knowledge of emergency medical staff in terms of laryngeal mask embedding (LMA) and Combitube was higher than nurses. This finding was also reported in the study by Guyette et al.[9] The study by Wiese et al. showed that laryngeal mask embedding is more effective than ventilation with Ambu Bag for airway management,[20] and therefore, retraining programs in this regard are crucial.

The knowledge of nurses and emergency medical personnel on CPR legal issues was not at an acceptable level; thus, it is essential to incorporate the legal aspects of CPR and appropriate examples on beginning or finishing CPR in retraining programs, as mentioned by Rittenberger et al. In this study, the knowledge of nurses and emergency medical staff on the use of interosseous infusion instead of injection into the endotracheal tube and induced hypothermia was poor, which is consistent with the results of previous studies.[10] Hence, this issue should be considered in retraining programs. Based on our findings, it is essential to hold continuous retraining

### Table 3: The association of education and location with CPR knowledge

| Variables | Emergency medical staff | Nurses | P value* |
|-----------|-------------------------|--------|----------|
| Education |                         |        |          |
| Nurse’s aides* | 56 (6) | Nursing technicians | 22 (2.1) | 0.39 |
| Emergency medical technicians | 58 (6.3) | Bachelor’s degree | 286 (21.3) |          |
| Bachelor’s degree | 33 (3.3) | Discontinuous bachelor’s degree | 13 (2.4) |          |
| Discontinuous bachelor’s degree** | 12 (1) | Graduate | 9 (1.3) |          |
| Location |                         |        |          |
| Headquarter | 29 (3.6) | Operating and emergency room | 106 (12.1) | <0.001 |
| Urban*** | 114 (9.8) | Special unit***** | 156 (21.3) |          |
| Road bases**** | 16 (2.3) | Internal ward | 68 (2.4) |          |

SD: Standard deviation, *Obtained from analysis of variance (ANOVA), †Significantly higher knowledge of advanced CPR than emergency staffs with bachelor’s and Discontinuous bachelor’s degree (P<0.05), **Significantly lower knowledge of advanced CPR than other emergency staffs with different degrees (P<0.05), ***Significantly higher knowledge of advanced CPR than other emergency staffs with different location (P<0.05), ****Significantly lower knowledge of advanced CPR than other emergency staffs with different location (P<0.05), *****Significantly higher knowledge of advanced CPR than personnel of other wards (P<0.05)

### Table 4: The differences in CPR knowledge between personnel with and without basic CPR training

| Variables | With basic CPR training | Without basic CPR training | P value† |
|-----------|--------------------------|---------------------------|----------|
| Emergency staff | | | |
| CPR laws | 5.4 ± 0.7 | 3.9 ± 1 | 0.04 |
| Airway management | 9.7 ± 1.9 | 6.6 ± 1.4 | 0.02 |
| External cardiac massage | 9.9 ± 1.4 | 6.5 ± 1.4 | 0.03 |
| Advanced CPR | 6.8 ± 1.5 | 6.5 ± 1.5 | 0.45 |
| Total knowledge of CPR | 28 ± 3.4 | 21.2 ± 3.1 | 0.018 |
| Nurses | | | |
| CPR laws | 6.8 ± 0.8 | 3.1 ± 1.5 | 0.003 |
| Airway management | 7.6 ± 1.5 | 4.2 ± 1.4 | 0.03 |
| External cardiac massage | 9.8 ± 1.4 | 7.2 ± 1.2 | 0.04 |
| Advanced CPR | 6.7 ± 1.6 | 6.5 ± 0.9 | 0.76 |
| Total knowledge of CPR | 27 ± 3.4 | 22.4 ± 3.1 | 0.01 |

SD: Standard deviation, CPR: Cardiopulmonary resuscitation, †Obtained from independent sample t-test
programs in academic centers on CPR for hospital nurses and emergency medical staff according to the latest guidelines of CPR.\(^1\)\(^2\)\(^3\)

Some limitations should be considered for interpreting our findings. First, our study was questionnaire-based and recall bias could be occurred. Second, we could not report our findings based on confounders including age and gender. Another limitation was low sample size in our study. Hence, further study considering mentioned limitations are needed in this regard.

**Conclusion**

CPR retraining courses based on the 2010 guidelines with greater emphasis on embedding laryngeal airway and Combitube, legal aspects of CPR, interosseous infusion, and induced hypothermia are required for hospital nurses and emergency medical staff.

**Acknowledgement**

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**Conflicts of interest**

There are no conflicts of interest.

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