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Original Paper

Cardiopulmonary Resuscitation Team Performance, Outcomes, and Associated Factors in Iran

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ABSTRACT

Introduction: The outcomes of Cardiopulmonary Resuscitation (CPR) depend on the performance of the CPR team. Poor team performance endangers patient safety and leads to poor CPR outcomes.

Objective: This study aimed to evaluate the performance of CPR teams in teaching hospitals of Zanjan, Iran, the resuscitation outcomes (patient survival/death), and the associated factors.

Materials and Methods: This observational descriptive-analytical study was conducted from June 2024 to February 2025 in two teaching hospitals affiliated with Zanjan University of Medical Sciences, Zanjan, Iran. Fifty in-hospital CPR events were evaluated over 10 months (five per month) using the Team Emergency Assessment Measure (TEAM). A total of 290 team members participated in these 50 events. Statistical analysis was performed using descriptive statistics, the Kolmogorov-Smirnov test, Spearman's correlation test, and the Mann-Whitney U test.

Results: The patients had a mean age of 71.38±6.68 years, were mostly male (60%), and had cardiac disease as the primary cause of CPR (74%). The total TEAM score was 30.2±7.02 (out of 44). The highest mean score was in the task management domain (5.88±1.45), and the lowest was in the leadership domain (4.84±1.71). The analysis revealed a significant difference in total TEAM score based on CPR outcome (P=0.001). There was a significant negative relationship with the call-to-arrival interval and total TEAM score (r=–0.582, P=0.001), a significant positive correlation between experience in critical care units and the teamwork domain score (r=0.323, P=0.022), and a significant negative correlation between team size and the teamwork domain score (r=–0.303, P=0.033).

Conclusion: The results reveal the suboptimal performance of the CPR team in teaching hospitals of Zanjan, particularly in the leadership domain. Education of teamwork and leadership skills and shortening of the call-to-arrival interval can improve the CPR team performance and CPR outcomes.

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Highlights

- CPR team performance can significantly affect patient outcomes.
- In teaching hospitals of Zanjan, the CPR teams have suboptimal performance, particularly in the leadership domain.
- CPR team experience in critical care units can improve patient survival.
- A larger team size and a longer call–to–arrival interval can reduce CPR effectiveness.

Plain Language Summary

The performance of the Cardiopulmonary Resuscitation (CPR) teams can affect the patient survival. Therefore, this study aimed to evaluate the performance of CPR teams in teaching hospitals of Zanjan, Iran. We found that while the team performed well in task management, their leadership skills need improvement. Factors such as team members' experience in critical care units can improve CPR outcomes, whereas larger team sizes and delayed arrival times can reduce them. To enhance CPR team performance, training in teamwork and leadership skills, along with faster response times, is recommended.

Introduction

Cardiac Arrest (CA) is a leading cause of death worldwide. It refers to the sudden cessation of systemic blood circulation and spontaneous breathing. It usually occurs without significant warning signs [1-3] and is accompanied by a cardiac dysrhythmia. The mean age of individuals with CA is around 65 years, with at least 40% under 65 years of age [4]. Each year, 350000–450000 individuals in the United States and 700000 in Europe experience CA [5, 6]. Cardiopulmonary Resuscitation (CPR) is the most important measure for CA management, and its outcomes depend on the timely performance of basic and advanced life support measures [7], CPR duration, underlying disease, the timely use of a cardiac defibrillator, and the CPR team members' knowledge and skillfulness [8]. Despite continuous revisions and improvements of CPR guidelines, only 6–9% of patients survive after CPR [9]. The CPR success rate in Iran for in-hospital CA varies from 2% to 27% across different studies [10-12]. CPR is a team-based measure, and its quality and success rely not only on team members' technical skills, but also on their non-technical skills [13] such as coordination, collaboration, communication, leadership, and teamwork [14] that allow team members to effectively work together and attain their common goals [15]. It is a determining factor of emergency condition management, and its ineffectiveness may negatively affect patient and public safety [16, 17].

The leader of the CPR team is usually a competent physician who determines the CPR plan [18]. According to the European Resuscitation Council (ERC), team structure, dynamics, and leadership significantly influence the performance of the interdisciplinary healthcare team during resuscitation [19]. Poor teamwork during CPR endangers patient safety, negatively affects CPR outcomes [20, 21], and may lead to lifelong disabilities or death in patients [22]. Several factors can affect the CPR team's performance, including culture, resources, education, guidelines, and team communication [23-25]. Although CPR guidelines emphasize non-technical skills, they lack strategies for improving teamwork, leadership, and communication [24]. Some studies reported that 70–80% of medical errors are due to poor communication and teamwork [25, 26]. Moreover, the conditions of patients and their companions, as well as intra- and extra-organizational factors, can affect teamwork [27]. Other effective factors include CPR onset delay, members' limited experience and skills, equipment shortages, environmental conditions, patients' conditions, and family actions [28].

To the best of our knowledge, there is scant research that has evaluated the performance of the in-hospital CPR team in Iran. Therefore, this study aimed to assess the performance of the CPR team in teaching hospitals of Zanjan, Iran, and find its influential factors.

Materials and Methods

This observational descriptive-analytical study was conducted from June 2024 to February 2025 in two teaching hospitals affiliated with Zanjan University of Medical Sciences, Zanjan, Iran. There were CPR teams working for 24 hours in these two hospitals with a predetermined monthly schedule and CPR announcement equipment. The team leaders were clinically competent, either physicians or specialty residents (e.g. emergency medicine, cardiology, anesthesiology, or internal medicine). The study population consisted of all CPR events performed in the hospitals. Using a census sampling method, all eligible CPR events during the study period were included. The sample size was determined to be at least 50 CPRs, based on a previous study reporting a Standard Deviation (SD) of 3.6 for teamwork scores, and considering a 5% significance level and a precision of 1 [29]. Inclusion criteria were CPRs for patients >18 years, CPR team size >3, and CPR duration >5 minutes. Incomplete documentation of CPR measures (the cases where the assessor could not determine the exact time and method of initiation because they were not present for direct observation from the very beginning) was the exclusion criterion.

The data collection instrument was the Team Emergency Assessment Measure (TEAM), supplemented by a demographic form designed to record relevant information of both patients and CPR team members. The TEAM was developed by Cooper et al. for the assessment of teamwork in emergency conditions [30]. It has 11 items measuring three non-technical teamwork skills, including leadership (n=2), teamwork (n=7), and task management (n=2), and one item measuring global teamwork performance. The items are rated on a scale from 0 ("never") to 4 ("almost always"). The total score of the instrument ranges from 0 to 44. Scores ≤33, 34–39, and 40–44 indicate poor, good, and excellent team performance, respectively. The total score of the global teamwork performance rating is 0–10; scores <7 and 9–10 indicate poor and excellent global performance, respectively [31]. Previous studies have confirmed the psychometric properties of the TEAM [32-34]. In our study, it was first translated into Persian and culturally adapted using a standard forward–backward method by two bilingual experts. Face and content validity were then evaluated by a panel of experts (n=10), including specialists in emergency medicine and cardiology. Both the Scale-Content Validity Index (S-CVI) and the average of Item-Content Validity Indices (S-CVI/Ave) were 0.92. Reliability was assessed in a pilot study on 10 CPR events. Two independent raters scored each event simultaneously. Inter-rater reliability was 0.87, indicating strong agreement, and internal consistency, measured by Cronbach's α, was 0.90.

For data collection, an independent rater visited the wards where CPRs were conducted during different work shifts. To minimize observer bias, the rater was introduced to the CPR team as a helping assistant to the supervisor, concealing their primary role as a research assessor. The rater observed eligible CPRs and completed the TEAM questionnaire immediately after each CPR concluded, ensuring the team remained unaware of the formal evaluation. SPSS software, version 27 was employed for data analysis. Categorical variables were described using frequency and percentage measures, and numerical variables were described using Mean±SD, median, and interquartile range. The Kolmogorov-Smirnov test revealed that some variables did not follow a normal distribution (P<0.05). Therefore, non-parametric methods, including Spearman's correlation test and Mann-Whitney U test, were used for data analysis.

Results

This study evaluated the non-technical skills of 290 CPR team members across 50 in-hospital CA events. The resuscitated patients were aged 57–82 years with a mean age of 71.38±6.68 years. Most patients were male (60%), and the most common leading cause of CPR was cardiac disease (74%). Their other characteristics are presented in Table 1. The total TEAM score of the CPR team was 30.2±7.02. The domain with the highest mean score was task management (5.88±1.45), while the lowest was leadership (4.84±1.71). The mean teamwork score was 19.48±4.4. Among the items, the lowest mean score was for item No.1 (2.32±0.98) and the highest mean score was for item No.10 (3.16±0.76) (Table 2).

As shown in Table 3, the total TEAM score had a significant negative relationship with patient age (r=–0.43, P=0.002), denoting poorer team performance for elderly patients. Moreover, the teamwork domain of TEAM showed a significant negative relationship with the number of team members (r=–0.303, P=0.033), suggesting poorer performance by larger CPR teams. The call-to-arrival interval also had a significant negative relationship with the total TEAM score (r=–0.582, P=0.001), indicating that longer intervals were associated with poorer CPR team performance. On the other hand, CPR team members' work experience in critical

Table 1. Sociodemographic characteristics of CPR team members (n=290)

Variables		No. (%)/Mean±SD
CPR outcome	Patient survival	18(36)
	Patient death	32(64)
Primary reason for the medical emergency	CA	37(74)
	Respiratory distress	5(10)
	Shock—all causes	5(10)
	Lower GCS	3(6)
Gender	Male	30(60)
	Female	20(40)
Patient's age (y)		71.38±6.68
Number of team members		5.8±1.01
Time from call to team arrival (min)		4.18±1.06
CPR duration (min)		40.24±6.56
Age of team members (y)		33.02±3.16
Work experience in a hospital (y)		9±3.02
Work experience in critical care units (y)		1.73±1.62

Abbreviations: CPR: Cardiopulmonary Resuscitation, CA: Cardiac Arrest, GCS: Glasgow Coma Scale.

care units had a significant positive relationship with the teamwork domain score (r=0.323, P=0.022).

According to the Mann–Whitney U test results (Table 4), the TEAM score was significantly different based on CPR outcomes (patient survival/death). Those with patient survival outcome had significantly higher scores in leadership (P=0.001), teamwork (P=0.001), task management (P=0.001), overall performance (P=0.001), and global rating (P=0.002), indicating that better team performance was related to more favorable CPR outcomes. Furthermore, clinicians who contributed to patient survival had significantly more extensive work experience, both in critical care units (P=0.001) and in hospitals (P=0.011). This indicates that greater clinical experience may be a critical factor contributing to effective team performance and, consequently, successful CPR. In contrast, for the CPR events with patient death outcome, there was a larger team size (P=0.001), longer call-to-arrival interval (P=0.001), longer CPR durations (P=0.001), and older patients (P=0.001). These findings imply that delays in response, extended resuscitation, larger team sizes, and high patient age may be negatively associated with CPR success. No statistically significant difference in CPR outcomes (survival and death) was found based on team members' age.

Discussion

This study evaluated the performance of the CPR team in teaching hospitals of Zanjan, the CPR outcomes, and influential factors for 50 in-hospital CPRs. The lowest performance score was found in the leadership domain, underscoring significant challenges in CPR team leadership, particularly in the absence of a designated team leader. CPR leadership is one of the most important factors in efficient CPR team performance [35]; CPR teams with better leadership deliver higher-quality CPR and faster defibrillation [15]. The American Heart Association (AHA) and the ERC recommend incorporating teamwork and leadership education into educational programs on advanced life support and resuscitation [36, 37]. For the item "the team prioritized tasks", the highest score was reported. The AHA guideline also emphasizes the importance of teamwork and task prioritization [36].

Table 2. The mean scores of the TEAM items and domains

	Variables	Mean±SD	Range	Median
Items	1. The team leader let the team know what was expected of them through direction and command	2.32±0.98	0–4	2
	2. The team leader maintained a global perspective	2.52±0.86	0–4	3
	3. The team communicated effectively	2.54±0.73	1–4	2
	4. The team worked together to complete the tasks in a timely manner	2.96±0.73	1–4	3
	5. The team acted with composure and control	2.72±0.78	2–4	3
	6. The team morale was positive	2.56±0.88	1–4	2
	7. The team adapted to changing situations	2.72±0.78	1–4	3
	8. The team monitored and reassessed the situation	3±0.83	1–4	3
	9. The team anticipated potential actions	2.98±0.91	1–4	3
	10. The team prioritized tasks	3.16±0.76	1–4	3
	11. The team followed approved standards and guidelines	2.72±0.83	1–4	3
	12. Global rating	6.6±1.7	3–9	7
Domains	Leadership	4.84±1.71	0–8	5
	Teamwork	19.48±4.4	12–27	19
	Task management	5.88±1.45	3–8	6
	Overall score	30.2±7.02	16–42	29

Study findings revealed that a larger CPR team size was associated with poorer non-technical skills. Therefore, it seems that large CPR team size negatively affects team performance, leadership, and communication. This may be due to the poorer communication clarity and poorer team coordination in larger CPR teams. The AHA recommends that CPR teams should include at least two members, while larger teams consisting of 3-5 members may have better performance [38]. In agreement with our findings, a study reported a significant negative relationship between CPR team size and CPR team performance, indicating that larger teams have poorer team performance [31]. Moreover, we found a significant negative relationship between CPR team size and patient survival, suggesting that larger teams are associated with lower patient survival. Coordination and collaboration among members are probably more difficult in larger teams; medium-sized teams consisting of 3-5 members may produce the best outcomes.

An inverse relationship was also observed between patient age and CPR team performance, suggesting that teams may perform less effectively when resuscitating older patients. This finding is consistent with those of previous reports [37, 39]. The lower survival rates among older adults likely reflect the greater burden of comorbid conditions in this population [40, 41]. There was a significant negative relationship between CPR team performance and the time from call to patient arrival. The recorded time in our study generally fell within the critical golden period for initiating CPR following CA. Maintaining intervention within this crucial window is vital for preserving neurological function and preventing irreversible damage to vital organs. Timely CPR onset and defibrillation are important to reduce the rates of post-CA complications and death. This is supported by evidence indicating a marked decline in survival likelihood with progressively delayed resuscitation efforts [21]. Nurses' long delays in starting CPR and using a defibrillator may indicate that they, as the first responders to CA, may fail to transform their knowledge and skills into timely and effective measures. In our study, the call–hospital arrival interval also had a significant relationship with survival rate, denoting that a shorter interval was associated with greater CPR success. Similarly, a previous study reported that call–arrival time had a

Table 3. Correlation between TEAM scores and patient- and team-related factors

Factors	TEAM score				
	Leadership	Teamwork	Task Management	Overall Score	Global Rating
Patient age	r=–0.37 P=0.007*	r=–0.43 P=0.002*	r=–0.46 P=0.001*	r=–0.43 P=0.002*	r=–0.38 P=0.006*
Number of team members	r=–0.225 P=0.116*	r=–0.303 P=0.033*	r=–0.213 P=0.138*	r=–0.267 P=0.061*	r=–0.33 P=0.019*
Time from call to patient's hospital arrival	r=–0.636 P=0.001*	r=–0.539 P=0.001*	r=–0.481 P=0.001*	r=–0.582 P=0.001*	r=–0.594 P=0.001*
Work experience in critical care units	r=0.166 P=0.250*	r=0.323 P=0.022*	r=0.197 P=0.171*	r=0.262 P=0.066*	r=0.263 P=0.065*
Work experience in a hospital	r=0.116 P=0.424*	r=0.24 P=0.094*	r=0.089 P=0.539*	r=0.181 P=0.207*	r=0.181 P=0.207*

*Spearman correlation test.

significant effect on CPR success [42]. It seems that the timely arrival of CPR team members is associated with greater coherence, coordination, motivation, and self-confidence, thereby increasing the CPR success rate.

The findings demonstrated that CPR team performance was higher among team members with greater work experience in critical care units. The CPR team members' knowledge and skills can affect CPR outcomes [43]. A study found that the survival rate after CPR performed by CPR specialists was higher than that performed by non-specialized staff [44]. Another study demonstrated that implementation of CPR by specialized skilled teams significantly improved patient survival rates [45]. We also found that the survival rate was higher when CPR was done by team members with experience in critical care units. It seems that care provision to critically-ill patients and great experience of CPR in criti-

Table 4. The TEAM scores and patient- and team-related factors categorized by CPR outcomes

Variables		CPR Outcome				P*
		Patient Survival		Patient Death		
		Mean±SD	Median	Mean±SD	Median	
TEAM	Leadership	5.94±1.66	6	4.22±1.41	4	0.001
	Teamwork	22.72±4.47	24.5	17.66±3.19	17	0.001
	Task management	6.78±1.39	7	5.37±1.24	5.5	0.001
	Overall score	35.44±7.08	38.5	27.25±5.03	28	0.001
	Global rating	7.61±1.68	8	6.03±1.45	6	0.002
Number of team members		5.22±0.55	5	6.13±1.07	6	0.001
Time from call to patient's hospital arrival		3.33±0.97	3	4.66±0.79	5	0.001
CPR duration		34.44±6.28	34	43.5±3.98	45	0.001
Team members' age		33.83±2.43	34	32.56±3.46	33	0.141
Work experience in a hospital		10.39±3.62	9.5	8.22±2.35	7.5	0.011
Work experience in critical care units		2.78±1.86	2.5	1.14±1.12	1	0.001
Patient age		66.61±5.78	64.5	74.06±5.62	74.5	0.001

CPR: Cardio Pulmonary Resuscitation.

*Mann-Whitney U test.

cal care units improve the competence of critical care staff in CPR and thereby improve the post-CPR survival rate. In the present study, the survival rate was lower when the CPR duration was longer. The CAs that need shorter CPRs are usually due to reversible causes, while the CAs that need longer CPRs are generally due to the hypoperfusion and hypoxic injury of the tissues and, hence, have poorer outcomes [6, 46]. We also found a significant difference in CPR team performance based on CPR outcomes. Non-technical skills such as communication, leadership, and teamwork significantly influence CPR quality [17, 18]. Poor leadership, communication, and teamwork in CPR teams may lead to permanent disabilities and even death in patients [22].

This study had some limitations. It was conducted only in teaching hospitals of Zanjan City with a relatively small sample size, which may affect the generalizability of the findings. The potential for observer bias should also be acknowledged, as team members were aware of the observer's presence.

In conclusion, the CPR team members in teaching hospitals in Zanjan have relatively poor non-technical skills, particularly in leadership. Strategies such as reducing the time between call and arrival, ensuring adequate experience of team members, field monitoring of team performance, and appointing competent team leaders can be used to improve CPR team performance and thus CPR outcomes. Educational programs and workshops on teamwork and leadership as well as environmental improvements such as dedicated elevators for CPR team are also recommended. The findings of this study can be used to restructure in-hospital CPR teams and develop interventions for teamwork improvement.

Ethical Considerations

Compliance with ethical guidelines

This study WAS approved by the Research Ethics Committee of Zanjan University of Medical Sciences, Zanjan, Iran (Code: IR.ZUMS.REC.1403.057). Written informed consent to participate in the study was obtained from all the participants before enrolment.

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Authors' contributions

Study design, data analysis, and writing the initial draft: All authors; Data collection: Yadolah Shirvani; Review and editing: Yadolah Shirvani, Mohammad Ali Yadegari, Abdolhossein Emami-Sigaroudi, and Fatemeh Masaebi. Final approval: All authors.

Conflict of interest

The authors declared no conflict of interest.

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