

Importance of leadership in cardiac arrest situations: from simulation to real life and back

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Summary

The 2010 American Heart Association guidelines now recommend leadership training in Advanced Cardiac Life Support courses. In this review we provide a comprehensive summary of data derived from clinical studies that investigated the importance of leadership in cardiopulmonary resuscitation (CPR). Only a few, mostly observational, studies have been conducted under real-life conditions because of the high heterogeneity of the situations, difficulties in capturing the initial phase of CPR, and ethical issues. Well-controlled studies in the human simulator can fill existing gaps and provide important insights. High-fidelity video-assisted simulator studies from different research groups have shown that a prolonged process of teambuilding is associated with significant shortcomings in CPR, whereas effective leadership improves team performance. In addition, randomised controlled studies have provided evidence that medical students receiving leadership training subsequently showed improved CPR performance, which was sustained after a follow up of 4 months. In addition, leadership is influenced by gender and other factors such as emotional stress. Future studies are needed to investigate cultural differences and how findings from the simulator can be transferred to real-life situations.

Key words: *resuscitation; simulation; leadership; human factors; gender*

Introduction

Delivery of immediate, sustained, high-quality cardiopulmonary resuscitation (CPR) is crucial for patient outcome after a sudden cardiac arrest [1]. Survival dramatically decreases, by about 10%, with every minute without CPR, and the risk of permanent brain damage increases substantially. For this reason, international guidelines recommend routine training in CPR for healthcare providers. So far, CPR courses have focused on technical knowledge. Nonetheless, the quality of CPR is often insufficient and the hands-off ratio remains high, as shown in several observational studies [2–7]. In addition to the importance of regu-

lar training in technical skills, nontechnical skills, such as teamwork and leadership, have been identified as important contributory factors influencing CPR performance [8–13]. As a consequence, the recent 2010 American Heart Association (AHA) guidelines have expanded their recommendations regarding teamwork and leadership training in Advanced Life Support (ACLS) and Pediatric Advanced Life Support (PALS) training as a class I recommendation (level of evidence B) [14, 15].

The quality of CPR technical skills, time to start CPR, preshock pauses and hands-on time are crucial to patient outcome after cardiac arrest [2, 16, 17]. However, there is growing evidence demonstrating the importance of nontechnical skills, such as effective leadership in resuscitation, as contributory factors for the effective use of these technical skills. Lack of leadership and poor teamwork have been shown to be associated with poor CPR performance and a poor clinical outcome [11, 17–24]. Effective leadership in these task-oriented situations requires specific coordination activities within a team, such as distribution and assignment of tasks and enforcement of rules and procedures, as well as cooperation and communication between team members [25, 26].

In this review we provide a comprehensive and up-to-date summary of current clinical studies that have investigated the importance of leadership in CPR. We will first focus on “real-life” studies, which vary in terms of clinical settings and patient populations. However, as standardisation in these clinical studies is challenging, especially with regard to heterogeneity of situations and to lack of data for the initial period, we then discuss findings from simulator studies, which have the potential to fill these gaps.

Leadership in real-life resuscitation

In 1999, Cooper and Wakelam published an interesting observational clinical study investigating the relationship between leadership behaviour, team dynamics and task performance in 20 resuscitation attempts [12]. They used the Leadership Behaviour Description Questionnaire (LBDQ) to measure how structure was established within the resuscitation teams. This questionnaire was originally developed

by the Ohio Leadership School to quantify leadership behaviour and was adapted by Cooper and Wakelam for medical emergencies (table 1). They also used a scale for team dynamics, which assessed aspects such as coordination and adaptability, and task performance. The study found that the degree to which the leader built a structure within the team correlated significantly with the quality of cooperation within the team as well as the quality of resuscitation. Interestingly, leaders who participated very actively themselves (“hands-on”), rather than standing back in order to monitor effectively the patient and the team, showed less effective leadership; the coordination in their teams was poorer and the teams showed inferior performance. Leaders with recent advanced life support (ALS) training were somewhat more likely to stand back and manage the team instead of being actively involved in the actual resuscitation attempt. On the basis of these findings, the researchers recommend that leaders should not be actively involved “hands-on”; rather, they should build a structure within a resuscitation team to improve team performance, and only occasionally launch themselves in if assistance is required – similar to a lighthouse that guides the team from a safe distance. This study, called “lighthouse leadership”, was among the first to focus on this topic and to show the importance of nontechnical skills in cardiac arrest situations [12]. These findings resulted in a recommendation on the importance of high quality CPR with little hands off time which was incorporated in the AHA guidelines in 2005.

In paediatrics similar findings have been reported; communication breakdowns and deficient leadership are estimated to contribute to up to 70% of perinatal deaths and injuries [27, 28]. One observational study looking at real-life neonatal resuscitation attempts found that leadership, communication and management were the three most important factors influencing the quality of teamwork behaviour [29]. These three components of teamwork were weakly but significantly associated with the quality of resuscitation performance. Interestingly, despite important differences between neonatal and adult resuscitation algorithms, these findings are in agreement with results of adult studies. One field study showed that the presence of a specialist senior physician not only enhanced collaboration within the team, but also improved technical performance in terms of rapid defibrillation, administration of adrenaline and establishment of a central venous access [30]. Even specialised and experienced teams seem to profit from clear leadership. Hoff and colleagues analysed videos of trauma resuscitations and found that if a leader was identified, the resus-

citation process was more structured, and adherence to algorithms was significantly improved [31].

However, despite the importance of these real-life findings, several problems remain unsolved. First, circumstances differ between different resuscitation situations and are therefore difficult to compare. Teams are also heterogeneous in size and composition. Second, for logistic reasons it is difficult to capture the important initial resuscitation period where teambuilding takes place; given the crucial importance of the initial period, this is a serious limitation. Investigating the initial phase in real resuscitations is difficult, because for the analysis of team interactions and communication, a sophisticated recording device that would capture the early phase would be pivotal. Third, there are also ethical concerns, as a study team may interfere with effective resuscitation attempts and thus may worsen patient outcome. For these reasons, researchers have used the patient simulator as an interesting means of filling this gap.

Opportunities with simulator studies in the field

High-fidelity medical simulation is an important educational tool for training healthcare workers and preparing them for emergency situations, such as cardiac arrest [14, 15]. Hands-on skills can be improved without risk of traumatising inexperienced rescuers [32–34]. It also allows rescuers to receive immediate and objective feedback based on the videotape of their performance [35]. Studies have shown the benefit of performance debriefings using CPR quality data from actual in-hospital cardiac arrests [24]. However, video-assisted debriefings after a simulator training session allow for additional training benefits by providing immediate, objective post-performance review, rather than relying on recollection of events [35]. With recent advances in technology, different situations can be simulated in a realistic environment. The life-sized high-fidelity manikins reproduce accurately the physiology of a patient. Vital signs, voice and continuous electrocardiogram monitoring can be simulated to mimic many clinical scenarios, including a cardiac arrest.

In addition to training, simulation also provides new opportunities for research into medical emergency situations, such as cardiac arrest [36, 37]. Unlike real-life emergency situations, the simulator provides the opportunity for a controlled, standardised experimental situation, in which multiple interventions can be applied and directly compared. In-room video recordings provide opportunities for a de-

Table 1: Leadership Behaviour Description Questionnaire (adapted from [12]).

Item	Statements
1	The leader let the team know what was expected of them (through direction and command).
2	The leader demonstrated the use of uniform guidelines.
3	The leader displayed a positive attitude.
4	The leader decided what should be done.
5	The leader decided how things should be done.
6	The leader assigned group members to particular tasks.
7	The leader made sure that his part in the team was understood by the team members.
8	The team leader planned the work to be done.
9	The team leader maintained definite standards of performance.
10	The team leader remained “hands off” throughout the scenario.

tailed analysis of the team interactions on different levels. Simulator studies have thus become an important research instrument, complementing and further advancing findings from real life.

Despite these merits, some limitations of simulator studies should be discussed. Although behaviour patterns in the simulator are very similar to those in real-life situations [36], it is unclear how strong the effects found in simulator studies would be in real-life situations [38]. Although several studies have demonstrated strong perceived stress, and emotional and motivational involvement of participants during the simulation, the actual stress experienced during a real cardiac arrest may still be more pronounced [11, 39]. Another concern is a possible Hawthorne effect in simulator studies: the use of video recording may artificially improve performance since participants are aware that they are being monitored.

Findings from simulator studies: importance of team composition, teambuilding and leadership

Simulator studies have investigated early teambuilding and the importance of team composition in different settings. For example, one simulator study found a positive association between leadership of nurses who respond first and resuscitation performance in the early phase of CPR before a physician joined the group [40]. However, in reality, team members often have not worked together previously and sometimes have never met before [41]. The study simulated this dynamic characteristic by including a change in group composition (the participating physicians and nurses). It was expected that leadership would also evolve in a dynamic way. Indeed, in all 20 participating groups, nurses handed over leadership to the incoming residents as soon as they arrived [40]. However, not all residents felt comfortable accepting the leadership role. These simulator results are in accordance with previous findings from real life. Specifically, a recent survey of internal medicine residents from a teaching hospital revealed that residents feel unprepared to lead cardiac arrest teams [40]. Half of them perceived the ACLS courses as insufficient to provide the necessary training for team leadership. Another study looked at the quality of junior physicians as team leaders in a simulated cardiac arrest during inter-hospital transfers [43]. The management of the cardiac arrest was performed well but there was insufficient task delegation to the paramedic and ambulance driver team members, and a lack of effective communication. However, given the status differences between experienced nurses and young physicians in training, hesitations and insecurities about adopting the leadership role are not entirely surprising [10]. Another interesting finding of this study was that senior physicians, who entered the room later in the crisis, supported group performance best not by taking over in terms of directive leadership but rather by asking questions that brought potential problems to the attention of the leading junior doctors.

Simulator studies have particularly focused on the process of teambuilding in the early and most vulnerable phase of resuscitation. In one randomised controlled trial of general

practitioners and hospital physicians, the effects of *ad-hoc* teambuilding were compared with the performance of preformed teams with regard to adherence to CPR algorithms [11]. Participants were assigned either to preformed teams with three physicians present when the cardiac arrest occurred or to *ad-hoc* teams with only one physician present initially and the two others joining after the cardiac arrest occurred. The *ad-hoc* teams had significantly less uninterrupted CPR time because of delays in the first defibrillation and administration of epinephrine, as well as an increase in interruptions during CPR; this suggests that the process of teambuilding may require mental capacity, which then is not available for CPR.

Training and teaching of leadership

Previous research has demonstrated that a good team leader should possess not only leadership skills but also effective communication skills, mutual performance monitoring, maintenance of guidelines and task management [5, 41, 44–46]. The extent to which leadership skills are stable personal characteristics, and to what extent they can be acquired through learning programs, is still debated [12, 47]. However, recent studies have provided strong evidence that team-leadership skills can in fact be improved through training [9, 48].

Leadership teaching programmes have improved the quality of neonatal resuscitation [28, 49]. In addition, specific leadership training showed positive results in adult resuscitation training [48]. Recently, we assessed, in a randomised controlled trial, whether teaching leadership translates into more leadership utterances and thereby improves CPR performance among medical students [9]. All students received a general debriefing on CPR algorithms after a baseline simulation. Subsequently, the students were randomly assigned to one of two arms: they received 10 minutes of instruction in either leadership skills or technical skills. Leadership instructions used in this trial are displayed in table 2. Over a 4-month follow-up, the teams instructed in leadership made more leadership utterances and performed significantly better with respect to CPR-relevant outcomes than did the teams with technical debriefing. They started resuscitation earlier and had more hands-on time. Importantly, a significant correlation between leadership statements and hands-on time was found, validating similar findings in previous observational studies. Comparable results were obtained in a recent simulator study, where good leadership skills were associated with shorter preshock pauses, a lower hands-off ratio and better overall performance [46]. Teaching leadership and teamwork also has shown to be effective in other studies, resulting in better teamwork and leadership behaviour in simulated resuscitations [48], and in neonatal [27] and paediatric resuscitations [13]. This research indicates that good leadership can be learned with training and is not restricted to those with inherent good leadership traits.

Observational studies have reported an association between quality of leadership and team performance in CPR [8, 12]. This finding was confirmed and expanded in simulator-based controlled trials: Compared with preformed teams, teams formed *ad hoc* showed both less leadership and a

worse team performance [11]. Compared with general practitioners, medical students at the time of graduation showed shortcomings in leadership and delays in crucial parts of CPR, but not in the quality of technical execution thereof [50]. In a recent randomised controlled simulator-based trial, a causal relationship between leadership and performance was finally proven: an intervention aimed at improving leadership improved leadership skills and thereby team performance [9].

Gender and leadership in resuscitations

Generally, there is only little published literature on the importance of gender in CPR teams. Still, one study found that female students displayed less leadership behaviour and had less hands-on time than male students [47]. In this study, male gender, extroversion and negative agreeableness predicted the number of leadership statements during a simulated resuscitation, while context knowledge, context experience and other personality traits had no effect beyond these significant predictors [47]. Interestingly, female students did not differ from their male colleagues in terms of the level of knowledge and in terms of overall communication statements, yet they made significantly fewer leadership statements. Thus, knowledge and amount of talking in general cannot explain these results. In line with the above findings are results from another recent study demonstrating that, in teaching sessions among first-year medical students, fewer women than men volunteered to become small-group leaders [51]. Such findings suggest that leadership training might specifically focus on encouraging female students. Clearly, more research into this is needed.

Association of stress and leadership during cardiopulmonary resuscitations

Cardiopulmonary resuscitation can produce considerable stress, and the experience of stress and overload may impair performance [10, 52, 53]. In team research in general, there is evidence that leadership becomes especially important during stressful episodes, with team members often expecting more leadership from high-status members [42]. Furthermore, leadership is known to influence the stress level of team members [55]. However, although a possible association between stress and leadership behaviour seems important, studies have focused on the effect of leadership on team stress, and we know of only one study that investigated the effect of stress on leadership behaviour in CPR;

this study (data submitted for publication) found no association between stress level and amount of directive leadership. Clearly, more research is needed in this regard.

Adaptability of leadership behaviours

The available evidence supports the importance of directive leadership. We must also emphasise, however, that leadership behaviour needs to avoid rigidity, and to maintain flexibility and adaptability. We have already mentioned a finding suggesting that senior physicians joining a team led by a resident should not simply “take over” but assume a mentoring role [56]. This ties in with findings from acute care teams in general, which suggest that leadership does not have to be confined to a single individual but may be shared in accordance with team members’ specialised knowledge and experience [25]. Furthermore, situations in which the issue is not implementation of existing rules but rather problem-solving in more ambiguous situations, such as finding the correct diagnosis in the light of unclear or even conflicting evidence, leadership behaviour that is less directive in terms of content but provides guidance towards an optimal process of deliberation may be more appropriate [56, 57]. Thus, directive behaviours should not be displayed indiscriminately; rather, aspects such as task, setting and team composition have to be taken into account. There are several well described curricula which are based on the principle that organisation is not dependent on “the team leader assigning tasks” [33].

Conclusion

In addition to real-life studies, recent high-fidelity simulation studies have advanced the field of CPR research, particularly in the context of leadership and communication. The ability to video record team performance in well-controlled settings has allowed a detailed and rigorous assessment of team interactions. Particularly, simulator studies made it possible to investigate the earliest, very vulnerable period of resuscitation. Although pre-existing leadership skills and talent without a doubt improve team performance, such skills can be improved in specific leadership teaching programmes. Such efforts are now recommended in the AHA guidelines. Still, studies are needed to see how well the simulator findings can be translated into real resuscitations. Finally, while our review indicates that directive leadership often is appropriate in cardiopulmonary resuscitation, such behaviours should not be displayed indiscriminately; rather, aspects such as task setting and team composition should be taken into account. In addition, is-

Table 2: Effective leadership instructions for teaching leadership (adapted from [9, 12]).

I	Assuming leadership is important: <i>Explaining the importance of leadership in a resuscitation situation</i>
II	Announce to your colleagues what you do and tell your colleagues what they should do! <i>Assign and distribute task according the algorithm (e.g. “I make the ventilation and you are in charge of chest compression”)</i>
III	Decide what to do, be affirmative <i>e.g. “we defibrillate now” (instead of “should we defibrillate?”)</i>
IV	Ensure adherence to algorithm! <i>Always ensure adherence to your instructions and to the algorithm (Make sure, that the person you advised really does what you told him/her to do and check, if the team’s performance adheres to the algorithm, refer to the algorithm)</i>
V	Make short and clear statements and address these explicitly to the person in charge!

sues of intercultural differences need to be resolved in future international collaborations.

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