Cardiopulmonary Resuscitation and Vital Function Failure Refresher Training Strengthen Healthcare Professionals’ Self-Assessed Abilities

A Questionnaire-Based Pilot Study

Marie-Louise Södersved Källstedt, PhD, RN
Lisa Remahl, MD
Fredrik Hessulf, MD
Simon Liljeström, PhD

Being able to detect a patient’s deterioration in vital body function early and being able to initiate cardiopulmonary resuscitation (CPR) early are critical skills in reducing mortality and morbidity of affected patients (Berdowski et al., 2010). For every minute that CPR is delayed, the survival rate decreases by approximately 10% among patients with ventricular tachycardia/pulseless ventricular fibrillation in out-of-hospital cardiac arrests (Berdowski et al., 2010; Ewy et al., 2015). Guideline recommendations for how CPR should be performed and repetition intervals for regular refresher training for healthcare professionals are equivalent both in the United States and Europe (Link et al., 2015, Soar et al., 2015).

Although resuscitation guidelines provide a logical sequential algorithmic approach, they have mainly emphasized technical tasks performed by individual rescuers. In the initial stage assessment, resuscitation and life-saving interventions are to be performed concurrently. This requires healthcare professionals to both use the ABCDE (airway, breathing, circulation, disability [level of consciousness], and exposure [expose skin]) approach and have the ability to recognize and treat a cardiac arrest in accordance with CPR guidelines. The focus on individual rescuers might have arisen because educational programs have not emphasized nontechnical skills, such as leadership, communication, and team interaction (P. O. Andersen et al., 2010; Robertson & Al-Haddad, 2013). Crisis resource management (CRM) was created to give awareness of limitations and weaknesses in teams and organizations (Oriol, 2006). It is well known that unsafe care more often originates from problems with nontechnical skills than from a lack of technical expertise (Allard et al., 2020). P. O. Andersen et al. (2010) categorized five areas of nontechnical skills (leadership, communication, situation awareness, maintenance of guidelines, and task management) that required improvement in cardiac arrest teams. Their study reports that many team leaders are inexperienced and that a reevaluation attempt is recommended before resuscitation ends. Training in the...
ABCDE approach in combination with CRM is often separated from CPR training.

Bliss and Aitken (2018) found simulation to be a strategy that improved nurses’ abilities to identify deteriorating patients. In their study, the nurses described that these improvements transferred into clinical practice in their work with patients. In our study, we want to create a pilot course where healthcare personnel can simulate both CPR and early recognition of failure in vital signs. The aims were to create a pilot course and to describe the self-assessed abilities of the healthcare personnel before and after simulated patient scenarios.

METHODS
The study was conducted as a pilot study with self-assessment pre- and posttraining. A survey questionnaire was completed by 63 healthcare professionals. Data were collected at two secondary care hospitals in two regions (Västmanland and Västra Götaland) in Sweden country. The healthcare professionals worked on both monitored units with the possibility of telemetry monitoring and nonmonitored units. The current study used the Revised Standards for Quality Improvement Reporting Excellence: SQUIRE 2.0 checklist (Goodman et al., 2016).

Ideally, training should be evaluated at Level 3 of Kirkpatrick’s evaluation framework (Kirkpatrick & Kirkpatrick, 2016). Because time and resources were limited, the current study was conducted as a pilot study at Level 1 (reactions on the learning self-assessed abilities) of Kirkpatrick’s evaluation framework. Healthcare professionals evaluated their own skills in simulated patient scenarios by a questionnaire at the beginning and at the end of the training course, during the time period April to October 2019.

Participants
Prerequisites for registering and participating in the pilot training course were having undergone a basic CPR course (Swedish Council for Cardiac Resuscitation, 2016) and participating in a 1-day course in early detection and treatment (proACT; Thoren, 2019). The participants who voluntarily took part in the pilot study at the clinical training centers were nurses and assistant nurses from two different regions in Sweden. Four to eight nurses and assistant nurses took part in each training session. One instructor lectured and participated in discussions, and three instructors ran the skills training and simulated patient case sessions.

Specifics of the team involved in the work with the training were that the instructors used were all nurses with experience from acute care and they were all instructors in CPR and proACT.

Refresher Training
The training course lasted 4 hours and included a lecture with discussions on concepts (1.5 hours), followed by some technical skill practice in ventilation and chest compression, use of the defibrillator, and skills in inserting a nasopharyngeal airway. This session was followed by three different simulated patient scenarios including both technical and nontechnical skills: one pure cardiac arrest case, one case detecting a critically ill patient with the ABCDE approach, and one scenario that started with detecting a critically ill patient with the ABCDE and then became a cardiac arrest (see Table 1). Participants were told the simulation scenario subject matter was on a topic they had studied in the basic CPR and proACT training. Each scenario ended with a facilitator-guided debriefing. Three phases were used in the debriefing: description, analysis, and application. The opening question from the facilitator to the participants in the debriefing was “I want you, together, to describe for me what just happened in the scenario, without judgment.” In the analysis phase, the facilitator asked the healthcare professionals to focus on discussion and reflection in relation to the learning objectives. In the application phase, the facilitator asked the questions “What are you going to do differently in your clinical practice tomorrow?” and “What went well today that you can use in a clinical setting tomorrow?” (Jaye et al., 2015).

The purpose of the pilot training course was to prepare healthcare professionals to treat an acutely ill patient safely and successfully and to act in accordance with the guidelines in CPR and the ABCDE method. After completing the training course, the participants were expected to be able to (a) provide early detection and treatment of a patient with a failure in vital functions, (b) work in accordance with the ABCDE method, (c) explain and understand the arrangement with the communication tool

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Patient Case</th>
<th>CPR Algorithm and/or ABCDE Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cardiac arrest in a pregnant woman</td>
<td>CPR algorithm</td>
</tr>
<tr>
<td>2</td>
<td>Patient with hypoglycemia or septic symptoms</td>
<td>ABCDE method</td>
</tr>
<tr>
<td>3</td>
<td>Anaphylaxis that triggers cardiac arrest</td>
<td>CPR algorithm over to ABCDE method</td>
</tr>
</tbody>
</table>

Note. CPR = cardiopulmonary resuscitation; ABCDE = airway, breathing, circulation, disability, and exposure.
The training materials consisted of CPR mannequins (Resusci Anne QCPR, SimMan Essential, Laerdal) that allowed quality control of chest compression and ventilation.

**Self-Assessment of Ability**

The questionnaire consisted of 21 validated questions used in other studies (Roh et al., 2013; Silverplats et al., 2020; Södersved Källstedt, 2011). Five of the questions addressing guidelines and concepts that were not included in the three original instruments were added to measure specific competence in these areas. Three of the questions were demographic (age, occupation, and work experience). Six questions were about guidelines and concepts. One question was about feeling safe in their profession before meeting a patient with failure of vital functions. The remaining questions were about skills in communication structure, performing chest compression, providing breathing, and leading the team.

With the exception of the demographic questions, all answers were categorized in three groups on a 7-point scale. Response options categorized as low response were strongly disagree and disagree; medium response were partly disagree, neither agree nor disagree, and partly agree; and high response options were agree and totally agree.

**Statistical Analysis**

Descriptive statistics were used to summarize data gathered in the study. The participants’ perceptions of their skills were analyzed in terms of proportions of agreement or disagreement with the questions. These proportions were tested using chi-square tests, with \( p < 0.05 \) considered statistically significant.

To further investigate the differences in self-reported skills, Cohen’s \( b \) for effect size was calculated (Cohen, 1988). Cohen’s \( b \) is a measure of the distance between two proportions and can be classified as a small \((b > 0.20)\), medium \((b > 0.50)\), or large \((b > 0.80)\) difference. A statistically significant result only tells us that there is likely to be a difference in the population, but an effect size, such as Cohen’s \( b \), quantifies this difference. Thus, the researcher can determine whether the difference is meaningful.

**Ethical Considerations**

The study was approved by the Ethical Committee in Uppsala Sweden (Dnr 2018/049). The investigation conforms with the principles outlined in the Declaration of Helsinki World Medical Association.

**RESULTS**

A total of 63 nurses (51%) and assistant nurses (48%) participated in the pilot training courses, all choosing to answer the questions both before and after the training. Most (44%) participants were in the 19- to 30-year age group. Most (59%) participants had 1–10 years of work experience in health care, 17% had worked 11–20 years, and 22% had worked over 20 years in health care. Missing data (item nonresponse) varied from 0 to 11% before training and from 0 to 3% after training.

Participants assessed their own professional abilities prior to meeting a patient with failure of vital functions. Before training, 26% fully agreed that they were confident in their ability to feel safe in the professional role. After the training, this proportion increased to 84.10% (\( p = 0.00025 \), effect size \( h = 1.272 \)).

<table>
<thead>
<tr>
<th>Question</th>
<th>Percent (% Agreements Before Training)</th>
<th>Percent (% Agreements After Training)</th>
<th>( p )</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel safe in the professional role.</td>
<td>25.40</td>
<td>84.10</td>
<td>0.00025</td>
<td>1.272</td>
</tr>
<tr>
<td>I have skills to lead and advise the CPR team.</td>
<td>12.70</td>
<td>71.40</td>
<td>0.00025</td>
<td>1.266</td>
</tr>
<tr>
<td>I have skills to lead and advise the alarm team.</td>
<td>11.10</td>
<td>69.80</td>
<td>0.00025</td>
<td>1.306</td>
</tr>
<tr>
<td>I have skills to give chest compressions in a CPR situation.</td>
<td>82.50</td>
<td>100</td>
<td>0.152</td>
<td>0.85</td>
</tr>
<tr>
<td>I can work in accordance with the ABCDE method.</td>
<td>39.70</td>
<td>81</td>
<td>0.013</td>
<td>0.871</td>
</tr>
<tr>
<td>I can communicate in a structured way.</td>
<td>34.90</td>
<td>77.80</td>
<td>0.0068</td>
<td>0.899</td>
</tr>
<tr>
<td>I have skills to assess when to switch from the ABCDE method to CPR guidelines.</td>
<td>28.60</td>
<td>81</td>
<td>0.00026</td>
<td>1.103</td>
</tr>
<tr>
<td>I am familiar with the CRM concept.</td>
<td>7.90</td>
<td>69.80</td>
<td>0.00025</td>
<td>1.408</td>
</tr>
<tr>
<td>I can work in accordance with the CRM method.</td>
<td>6.30</td>
<td>65.10</td>
<td>0.00025</td>
<td>1.38</td>
</tr>
</tbody>
</table>

**Note.** CPR = cardiopulmonary resuscitation; ABCDE = airway, breathing, circulation, disability, and exposure.
their abilities to treat a patient with failure in vital functions. After training, 84% were in complete agreement, giving a large effect size (see Table 2). Other skills with large effect sizes were leading and advising the CPR team, giving chest compression in a CPR situation, working in accordance with the ABCDE and CRM methods, familiarity with the CRM concept, communication structure, and assessing when to switch from the ABCDE method to the CPR guidelines.

The participants estimated their cardiac arrest skills, such as CPR. Before training, 69% did not agree with the statement that "my professional skills are not enough to use the latest guidelines for CPR." After training, 89% disagreed, giving a medium effect size. Other areas with medium effect sizes after the training were that the participant’s knowledge was insufficient to use the ABCDE method, that the participant would hesitate to perform defibrillation because they feared injuring the patient, and that the participant had the skills to give breaths in a CPR situation.

The participants assessed whether the combined CPR and proACT refresher training strengthened their own abilities to respond to an acute event of a patient with a failure of vital functions; 94% agreed that it did, and 93% agreed that mixing scenarios with different patient diagnoses (instead of knowing in advance that the diagnosis was a cardiac arrest, as in traditional CPR refresher training) provided a real-life learning environment. Before the training, 57% of participants disagreed with the statement that "guidelines in healthcare limit staff independence," compared with 70% after the training.

DISCUSSION

A pilot training course for refresher training was developed. The purpose of the training was to ensure that healthcare personnel maintained their competence in the early detection and treatment of patients with a failure in vital functions and to be able to act in accordance with CPR guidelines. It is encouraging that this combined training enhanced the participants’ confidence in their ability to treat a patient with a failure in vital functions.

The combined training described here offers nurses and assistant nurses’ real-life practice in determining the patient’s problems and the measures required to stabilize them. In traditional CPR-only training (Soar et al., 2015; Swedish Council for Cardiac Resuscitation, 2016), the participant knows in advance that the patient scenario will be a cardiac arrest. This condition makes it difficult to simulate a surprise moment that will gauge the mental preparation required for healthcare professionals to determine whether they are treating a cardiac arrest or some other acute event. The nurse’s role in active patient care is to detect a deteriorating patient and subsequently decide upon appropriate actions (Butler, 2018).

After completion of the training in the current study, nurses and assistant nurses are expected to be able to apply their skills to patient care. The current study does not follow up on whether healthcare professionals can actually implement the skills in patient care (Kirkpatrick’s Level 3) while remaining at Kirkpatrick’s Level 1. Indirectly, the result reflects Kirkpatrick’s Level 2, how the healthcare professionals acquired learning. No objective data reflecting Level 2 are available in this study. Other studies have shown that simulation training affects patient care in a positive way (McGaghie et al., 2011), and it is assumed that this is the case here.

The current study indicates that training that uses mixed scenarios with different diagnoses provides a real-life learning environment and strengthens the abilities of nurses and assistant nurses to respond to an acute event of a patient with vital function failure. Further studies are needed, for example, observational or knowledge control studies, to obtain objective data on the healthcare professionals’ knowledge and skills. An observational study with peer-to-peer learning to obtain objective data is planned. We encourage others to evaluate while designing and replicating mixed real-world scenarios in refresher training. Gaba (2010) advocates that CRM and team training should be created to meet healthcare professionals’ needs.

Although it is important to train healthcare professionals in technical skills and to prioritize the training of individual critical skills (S. A. W. Andersen et al., 2019), it is equally important for teams to practice the CRM method with non-technical skills (Gjeraa et al., 2014). Important factors for successful implementation and continuation of the opportunities for healthcare professionals in refresher training are the presence of leaders who can prioritize the training and the availability of trained facilitators who can align training with learning objectives (Gjeraa et al., 2014). It is well known that CPR knowledge decreases if ongoing CPR training is not carried out, indicating that regular refresher training is important for healthcare professionals to maintain their skills (Anderson et al., 2019).

Limitations

A limitation of the study is that only a small number of nurses and assistant nurses from one single country participated. Strengths are that all participants chose to self-assess their abilities and that they represented professionals from both monitored and nonmonitored departments, meaning that the study may be of interest to other hospitals where nurses and assistant nurses undergo refresher training.

CONCLUSION

Using scenarios with different patient diagnoses in simulation training provides a realistic learning environment. Combining refresher training for CPR and early recognition of an acute situation strengthens the perceived abilities of healthcare professionals to respond to patients with failure of vital functions.
Data availability statement. The data sets used and/or analyzed during the current study will be available from the corresponding author in response to reasonable requests.

Key points.

-Healthcare professionals felt their professional ability to respond to an acute situation with a patient with failure of vital functions improved after the training.
-Effective effect sizes after refresher training were found in the skills required to lead and advise the CPR team, in communication structure, in working in accordance with the ABCDE and CRM methods, and in the skills required to assess when to switch from the ABCDE method to the CPR guidelines.
-Refresher training that uses mixed scenarios with different diagnoses provides a real-life learning environment.

SDCs
Supplemental Digital Content 1, http://links.lww.com/JNPD/A41. Age of the participants.

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References