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Automated testing combined with automated retraining to improve CPR skill level in emergency nurses

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ABSTRACT

Objectives: To investigate the effect of automated testing and retraining on the cardiopulmonary resuscitation (CPR) competency level of emergency nurses.
Methods: A software program was developed allowing automated testing followed by computer exercises based on the Resusci Anne Skills Station™ (Laerdal, Norway). Using this system, the CPR competencies of 43 emergency nurses (mean age 37 years, SD 11, 53% female) were assessed. Nurses passed the test if they achieved a combined score consisting of ≥70% compressions with depth ≥50 mm and ≥70% compressions with complete release (<5 mm) and a mean compression rate between 100 and 120/min and ≥70% bag-valve-mask ventilations between 400 and 1000 ml. Nurses failing the test received automated feedback and feedforward on how to improve. They could then either practise with computer exercises or take the test again without additional practise. Nurses were expected to demonstrate competency within two months and they were retested 10 months after baseline.
Results: At baseline 35/43 nurses failed the test. Seven of them did not attempt further testing/practise and 7 others did not continue until competency, resulting in 14/43 not competent nurses by the end of the training period. After ten months 39 nurses were retested. Twenty-four nurses failed with as most common reason incomplete release.
Conclusion: Automated testing with feedback was effective in detecting nurses needing CPR retraining. Automated training and retesting improved skills to a predefined pass level. Since not all nurses trained until success, achieving CPR competence remains an important individual and institutional motivational challenge. Ten months after baseline the combined score showed important decay, highlighting the need for frequent assessments.

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Introduction

Emergency nurses are often involved in the management of cardiac arrest. Lack of cardiopulmonary resuscitation (CPR) skills of nurses and physicians contributes to poor outcome of cardiac arrest victims (Perkins et al., 2008; Passali et al., 2011; Xanthos et al., 2012; Smith et al., 2008; Seethala et al., 2010). Despite CPR training efforts, acquisition of compression and ventilation skills are often poor and they decay rapidly (Chamberlain et al., 2002; Jones et al., 2007). Nurses have a professional responsibility to remain competent in CPR through regular updates. The use of frequent assessments may identify those individuals requiring additional training (Andresen et al., 2008; Castle et al., 2007; Wik et al., 2005; Christenson et al., 2007; Niles et al., 2009). Although recommended by the European Resuscitation Council (ERC) and by the American Heart Association (AHA) systematic testing of healthcare providers after a course or after a predefined interval is still not current practice. According to Dwyer and Moser Williams (2002) CPR training strategies that encourage nurses to update CPR skills should be developed. The purpose of the current study was to investigate the effect of automated testing combined with automated retraining on the CPR competency level of emergency nurses.

Background

As nurses are often the first professionals to encounter a person in cardiac arrest, the effectiveness of their actions has a significant effect on survival (Nyman and Sihvonen, 2000; Madden, 2006). It is therefore essential that effective instructional strategies are implemented to ensure high-quality resuscitation performance. Some investigators (Lynch et al., 2007) stated that instructors' judgement alone is not sufficient to determine CPR competence. As an alternative to assessment by instructors we previously developed an automated testing station enabling formative assessment and certification procedures in a time-efficient manner without instructor involvement (Mpotos et al., 2012). Automated assessment also offers the possibility to provide an immediate and accurate test result (= feedback) together with information on how to further improve (= feedforward), which according to Hattie (2009) is the most powerful tool for learning improvement. This technological advance can reduce recertification time and allow focused individualised retraining.

CPR skill performance is defined by the international guidelines for resuscitation (American Heart Association and European Resuscitation Council). These guidelines recommend that training should be tailored to the needs of different types of learners and learning styles to ensure adequate acquisition and retention of skills (Soar et al., 2010). The AHA guidelines (2010) emphasize the importance of simplification of CPR instruction to focus on competence in the small set of skills most strongly associated with the victim's survival. Delivery of chest compression is the CPR skill most likely to improve survival and therefore a method for valid determination of rescuers' competence to perform this skill is important (Lynch et al., 2007). As such, educational interventions need to be evaluated to ensure that they achieve the desired educational outcomes. According to Mäkinen et al. (2007) various methods to assess CPR skills are currently used, often with methodological shortcomings. It has been stated (Wass et al., 2001) that clinical competence should be assessed against a predefined pass level. Since no specific CPR related research is available to propose a benchmark, we built on general principles as derived from Mastery Learning research indicating that a high attainment level has to be pursued before moving to the next learning goal and that formative assessment should be adopted to give immediate feedback. In this context, Hattie (2009) reported that Mastery Learning approaches result in high effect sizes (ES) when considering the impact on learning performance (ES = 0.58). Building on this knowledge a combined assessment score using a 70% cut-off was established by our research group (Mpotos et al., 2013) allowing more comprehensive reporting of overall CPR quality than reporting each skill separately. However, the relative importance of each individual skill and the exact relationship between skill level after training and real-life CPR performance are currently unknown.

Research design

The Ethics Committee of Groeninge General Hospital (Kortrijk, Belgium) approved the study. From March 2012 until January 2013, 43 of the 51 emergency nurses gave informed consent and participated in the study. Eight months prior to the study all nurses had been trained with the commercially available Resusci Anne Skills Station™ (Laerdal, Norway) computer exercises.

A self-learning station equipped with a manikin linked to a computer was available in a small room secured with a numeric lock, accessible 24 h a day and seven days a week (Mpotos et al., 2011a, 2011b). For the purpose of the study, a software program was developed to allow automated testing with feedback/feedforward (Ghent University, Belgium) combined with automated self-training sessions on a CPR manikin (Resusci Anne Skills Station™, Laerdal, Norway). As such we created short self-learning sessions where the nurses could repetitively test or test-practice-test until they achieved the required predefined pass level. Practising and testing was done on a full size torso disposed on the floor and using a bag-valve-mask device while performance of chest compression depth, complete release, rate and ventilation volume was registered. Each emergency nurse was invited to perform a first automated test (resuscitate a victim of cardiac arrest during 2 min) in order to establish baseline CPR skill level (T0; basic life support). To pass the test, nurses had to achieve a 70% combined assessment score consisting of $\geq$70% compressions with depth $\geq$50 mm and $\geq$70% compressions with complete release (<5 mm) and a mean compression rate between 100 and 120/min and $\geq$70% ventilations with a volume between 400 and 1000 ml. After each test an instant result was provided on screen (feedback). Nurses who failed the test were also informed about how to improve their individual skills (feedforward). They could then choose to perform a new test or first practice. Both could take place immediately or at a different moment, in which case the feedback and feedforward of the last test was recalled at the beginning of the new session (= feedup). Practice was done using full CPR computer exercises (30 ventilations to two compressions) with concurrent voice feedback (Resusci Anne Skills Station™ with limits set according to the ERC 2010 guidelines) and followed by a new 2 min test.

All nurses were asked to achieve a pass score on the test within a two months period (T1).

Ten months after the baseline measurement each nurse was invited to perform a new test (T2). Before performing the new test the result of the last performed test was displayed on screen. Not competent nurses also received feedforward on how to improve. Participants were sent up to three reminders in order to encourage them to participate in the retest. The participants flow chart is shown in Fig. 1.

Performances at baseline (T0), following training (T1), and after ten months (T2) were compared. Proportions are reported as counts and percentages. Confidence intervals (CI) are reported for the differences in proportions between T0–T1 and T1–T2.