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Simulation and education

The effect of different retraining intervals on the skill performance of cardiopulmonary resuscitation in laypeople—A three-armed randomized control study[☆]Ming-Ju Hsieh^a, Wen-Chu Chiang^{a,b}, Chyi-Feng Jan^c, Hao-Yang Lin^a, Chih-Wei Yang^{a,d,e,**}, Matthew Huei-Ming Ma^{b,d,*}^a Department of Emergency Medicine, National Taiwan University Hospital, Taipei, Taiwan^b Department of Emergency Medicine, National Taiwan University Hospital Yun-Lin Branch, Yun-Lin County, Taiwan^c Department of Family Medicine, National Taiwan University Hospital, Taipei, Taiwan^d Institute of Epidemiology and Preventive Medicine, National Taiwan University, Taipei, Taiwan^e Department of Medical Education, National Taiwan University Hospital, Taipei, Taiwan

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ABSTRACT

Aim: Our study aimed to compare cardiopulmonary resuscitation (CPR) performance among laypeople with different retraining intervals.**Methods:** Ninety-six non-medical university students were randomly allocated into 3 groups after receiving initial CPR and automated external defibrillator (AED) training. Sixty participants completed the study. The participants in the 3-, 6-, and 12-month groups received the same retraining every 3-, 6-, and 12 months. An 80-min retraining course comprised a video lecture and hands-on practice, with feedback from the instructors and the Resusci Anne[®] QCPR. The primary outcome was a skill pass rate one year post-initial training. The secondary outcomes included a skill pass rate prior to each retraining course, knowledge test scores, and individual skill performance evaluated by assessors and by SkillReporter[®] software one year post-initial training.**Results:** The characteristics among the groups were similar. The 3-month group had the highest pass rate (3-month group: 6-month group: 12-month group, 100.0%: 78.9%: 19.0%, $p < 0.001$) in the primary outcome. In secondary outcomes, the 3-month group had a higher pass rate than the 6-month group at 6 months post-initial training. The 3-month group achieved the highest knowledge test scores, and performed best in many ventilation items. They showed similar performance to the 6-month group and better performance than the 12-month group in chest compression items. The 3 groups performed similarly in AED manipulation.**Conclusions:** Although young laypeople with a 3-month retraining interval had the highest pass rate when performing conventional CPR, a 6-month retraining interval may be considered for training compression-only CPR and AED when balancing outcomes and resources.

Introduction

Sudden cardiac arrest (SCA) accounts for 420,000 and 275,000 deaths per year, in the US and Europe, respectively [1,2]. The survival of out-of-hospital SCA victims has been largely determined through the timely performance of cardiopulmonary resuscitation (CPR) and defibrillation using an automated external defibrillator (AED), by bystanders [3–5]. The quality of CPR has also been associated with clinical outcomes for SCA victims [6–8]. To improve SCA survival, it is important to increase the rates and improve the quality of bystander

CPR and the use of AED in the community.

Recently, the number of bystander basic life support (BLS) courses and public-access AEDs has rapidly increased internationally, and this increase has seen improved SCA survival rates [9–12]. In addition, it has also been recommended that dispatchers should provide chest compression-only CPR instructions to callers for adults with suspected out-of-hospital cardiac arrest [3,5,13]. Therefore, teaching compression-only CPR for adults with SCA could be considered in the community [14].

The optimal interval for BLS retraining for laypeople to maintain

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their skills remains unclear. Previous studies have shown rapid deterioration in conventional BLS skills within 3- to 12 months post-initial training [15], and most recommendations based on current evidence suggest that individuals more likely to encounter cardiac arrest should consider more frequent retraining than the standard retraining period of 12- to 24 months, to maintain the skills [14,16,17]. Additionally, training course content may include conventional CPR or chest compression-only CPR, and may or may not offer AED training, which makes determining the best retraining interval difficult. As such, it is important to determine the optimal retraining interval for CPR and AED courses for laypeople. Our study aimed to evaluate the effect of different retraining intervals for CPR and AED courses undertaken by laypeople on the various components of skill performance.

Material and methods

Study design

This was a randomized controlled trial with three parallel arms, involving students of the university and the graduate institute. The study received approval from the Institutional Review Board of the National Taiwan University Hospital. We conducted and reported the study in accordance with the Consolidated Standards of Reporting Trials statement [18].

Recruitment and randomization

Study participants were recruited from students attending 4 BLS courses, which were conducted for non-medical students of the university and the graduate institute at the Health Center of the National Taiwan University, from April to June in 2014. Before each course, the study investigator introduced the study and responded to any questions. The students were advised that their course results did not depend on whether they participated in the study, and that they would be given a gift certificate valued between \$6.50 and \$26, according to the number of participating retraining courses they attended, to thank them for their participation. They were then instructed to contact the study investigator immediately after passing the BLS course if they wished to join the study, and eligible volunteers signed the consent forms. The inclusion criteria for study participants were as follows: (1) students over 18 years; (2) students without prior CPR training, or whose last course was more than 2 years prior to the study; and (3) students passing the training course test in which the study was introduced. Students with a physical condition that rendered them unable to perform CPR were excluded from our study.

After informed consent was obtained, eligible participants completed a survey which included information on name, age, sex, height, weight, the time of any previous CPR training and contact information. On completion of all 4 BLS courses, the participants were randomized into 3 groups by drawing lots, into a 3-month group, a 6-month group, and a 12-month group. The 3-month, 6-month and 12-month groups had retraining intervals of 3, 6, and 12 months, respectively. The participants were blinded to their assigned groups until they were contacted to join the retraining course.

Initial training and re-training program

All eligible participants received the same training and retraining courses. The duration of the initial training course was 4 h, including: a 40-min didactic lecture and a 23-min video instruction; a 20-min demonstration on how to perform conventional CPR and how to use an AED; a 90-min hands-on practice session; and a 50-min introduction to the Heimlich maneuver including a hands-on practice session. The ratio of instructors to participants was 1:6, and the ratio of manikins to participants was 1:3. During the hands-on practice session, the participants practiced CPR and AED using a Resusci Anne® QCPR manikin

(Laerdal Medical, Stavanger, Norway) and received automated feedback from the manikins in addition to the instructors' feedback. The participants watched a screen situated alongside the manikin to acquire real-time feedback on the performance of the compression position, compression depth, compression rate, chest recoils and ventilation volume, as they practiced CPR. The feedback from the instructors covered other skills, such as checking environment safety, checking for consciousness and breathing, calling for help, checking the posture when performing CPR, and the use of the AED. One study showed that students who received feedback from a manikin and from an instructor during hands-on practice sessions demonstrated significantly better BLS skills than those who only received feedback from an instructor [19]. Following the hands-on practice session, the participants had their knowledge tested. The tests comprised 20 multiple choice questions and a skills test. The skills test scenario required them to deal with a middle-aged man who had collapsed suddenly in front of the participants as they were walking in the park. Each participant was required to demonstrate how they would react to this scenario, using the manikin. The duration of CPR was 2 min, which started from the first chest compression. After 2 min of CPR, an AED was given to the participant. The skills test was completed when the participant resumed chest compressions after performing a shock with the AED, or 2 min after acquiring an AED.

After the initial training, the participants were recalled to join retraining courses according to their assigned randomized group. The retraining courses included a 23-min video instruction and a 60-min hands-on practice session. The participants also received real-time feedback from the Laerdal® Resusci Anne® QCPR manikins and from the instructors, similar to the initial training course. The retraining instructors were blinded to the group the participants belonged to. The ratios of instructors to participants, and manikins to participants, were the same as in the initial training. Before and after the retraining course, the participants underwent a knowledge test and a skills test, as a pre- and post-test. The content in these tests was the same as the tests post-initial training. If the participant did not pass the skills test after each retraining course, a 15-min repeat hands-on practice session was given. Participant performance throughout all the skill tests in the retraining courses was recorded using a camera and using the Laerdal® Resusci Anne® Wireless SkillReporter™ software.

Outcome measurement

On a separate occasion, two blinded assessors reviewed the recorded videos and evaluated the participants' performance during the skills test using a checklist. The checklist included a list of skills required to perform CPR and AED, as listed in the guidelines [20,21]. Before evaluating the skills performance, the assessors reached agreement on how to evaluate the performance of each skill. A participant would pass the skills test if the skills, including chest compressions, ventilation, and use of the AED, had been performed to a level reaching at least 60% for each individual skill requirement. The primary outcome was the pass rate of the skills test one year after the initial course. The secondary outcomes were knowledge test scores, individual skill performance as assessed by evaluators and recorded using the SkillReporter™ software one year after initial course, and the pass rate of the skills test on the pre-test of each retraining course in the 3 groups.

Sample size estimation

We hypothesized that the 3-month group had a skill pass rate of 100%, and the 12-month group had a skill pass rate of 71% one year after initial training, using a two-tailed $\alpha = 0.05$, $\beta = 0.2$ [22]. We considered the attrition rate to be 70%. Therefore, it was expected that at least 32 participants in each group were necessary.

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