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Self-learning versus Instructor-led Learning in Basic Life Support Training

A Randomized Controlled Trial

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1. INTRODUCTION

Basic life support (BLS) skills are essential in the care of cardiac arrest victims, but unfortunately only a minority of cardiac arrest victims receive bystander or first responder cardiopulmonary resuscitation (CPR) (1, 2). For cardiac arrest victims the quality of CPR delivered by healthcare professionals is critical, because poor compliance with recommended guidelines has been associated with lower survival rates (3, 4). Healthcare professionals usually receive their first training in BLS in the beginning of their professional education, but the long-term retention of their learning is a more important outcome parameter than learning assessed at the time of the training (1). There is insufficient evidence to recommend the optimal interval or method for BLS retraining (1, 2), however there is low-quality evidence of skills decay within 3 to 12 months after BLS training (5-7) and evidence that frequent training improves responder confidence (5, 8) and willingness to perform CPR (8).

Traditional BLS training is given in groups of various sizes, with one or more instructors. It has been shown that groups of three, five, and eight students do equally good in a post-test, however the group with eight students had significantly less hands-on time, asked fewer questions, conducted more unrelated conversations and ranked themselves lower in self-assessment than groups of three(9). A alternative method to teach BLS is via computer and/or video. Students in a computer-based learning BLS course have been shown to perform with a significantly higher accuracy rate on 60 chest compressions, 12 ventilations and 3 cycles of CPR than students in an instructor-led group (10), and another study showed that skills acquired in a self-learning station combining video-instruction with training using voice feedback were not inferior to instructor-led training (11).

The advantages of self-learning compared to instructor-led training are many. When no instructor is needed, the training can take place when it fits the student best; the student only needs a computer and a manikin. Retraining can take place more often because a course does not have to be planned, and salary for the instructor is saved. The disadvantage of self-learning is the lack of feedback from an instructor, but with voice feedback from the manikin, the student receives feedback regarding the quality of the CPR. The manikin assesses compression depth, correct hand position, correct decompression, compression rate, respiratory volume, respiratory frequency, gastric ventilation (12) and gives voice feedback on those parameters.

A method to assess the quality of CPR is by using the Resusci Anne SkillReporter™ (Laerdal Medical, Stavanger, Norway). The Resusci Anne SkillReporter™ (LSR) is an adult CPR training manikin that focuses on student performance through printed reports on ventilation and compression

compliance. Regarding ventilation trainees obtain measurements on ventilation volume, number of ventilations per minute, overall ventilation volume, number of ventilations, percentage of correct ventilations, number of ventilations with too much volume, number of ventilations with too little volume, number of ventilations that were too fast, and the relation between ventilations and compressions. Regarding compression the Resusci Anne SkillReporter gives feedback on compression depth, number of compressions per minute, compression frequency, total number of compressions, percentage of correct compressions, number of compressions that were too deep, number of compressions that were too shallow, incorrect hand position, incorrect decompression. Another method to assess the CPR is to check if all steps in the CPR-algorithm are fulfilled. A BLS/AED provider assessment record is available via the European Resuscitation Council(13) (fig.2).

Mini Anne CPR & AED (Laerdal Medical, Stavanger, Norway) is a manikin developed to train CPR skills. This innovative self-directed learning programme allows people to learn the core skills of CPR and automatic extern defibrillation (AED) use in 30 minutes. The Mini Anne CPR & AED kit instructs the user in a 'practice-while watching' format with the aid of a 30 minute instructional DVD, and a personal, inflatable manikin with an integrated adult/child compression clicker[1]. The first year medical students from Bern University Hospital use this manikin in their obligatory BLS course integrated in their first aid training. After a short introduction to the course they train CPR skills for 30 minutes with the Mini-Anne supervised by the instructor. After the training the course continues with four different scenarios. The duration of the first aid course is three hours.

In the "2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Care Science with Treatment Recommendations"(1) it was stated that there was a knowledge gap regarding the skill performance in actual resuscitations of students receiving self-instruction courses when compared with those receiving traditional courses (1). To expand our knowledge we wish to investigate whether there is a difference in the BLS skills in first year medical students directly after training and four months later, when randomly assigned to self-learning versus instructor-led training courses. Our 0-hypothesis is that the students in the self-learning group will not be inferior to the students in the instructor-led group.

2. AIM OF STUDY

The aim of this study is to investigate whether self-learning versus instructor-led learning results in the same BLS skills in first year medical students directly after training and four months later.

[1] http://www.laerdal.com/gb/MiniAnne#/Info

3. HYPOTHESIS

Our 0-hypothesis is that the students in the self-learning group will demonstrate the same BLS skills as students in the instructor-led group. The alternative hypothesis is that there will be a difference in the BLS skills demonstrated by the self-learning group compared to the instructor-led group.

4. OBJECTIVES AND OUTCOMES

4.1. Objectives

The objective of this study is to compare the BLS skills measured by the percentage of correct compressions achieved directly after BLS skills training in a self-learning group compared to an instructor-led group using the printed report from the LSR and the score on the standardized ERC BLS/AED provider assessment record(13) (fig.2). Another objective is to investigate the degree of competence loss after four months.

4.2 Outcomes

Our primary outcome will be the percentage of correct compressions obtained from the printed report from the LSR. With this parameter we will compare the two groups directly after the first teaching session.

Our secondary outcomes are:

- The subcomponents of the printed report from the LSR (ventilation volume, number of ventilations per minute, overall ventilation volume, number of ventilations, percentage of correct ventilations, number of ventilations with too much volume, number of ventilations with too little volume, number of ventilations that were too fast, the relation between ventilations and compressions, compression depth, number of compressions per minute, compression frequency, total number of compressions, percentage of correct compressions, number of compressions that were too deep, number of compressions that were too shallow, incorrect hand position, and incorrect decompression).
- The score on the BLS/AED provider assessment record(13) (fig.2).
- Degree of loss of competence after four months for all the primary and secondary outcomes.
- Influences of gender and prior BLS training will also be investigated, as well as the decay of competences.

5. PROJECT DESIGN

5.1. Type of research and general project design

This is a randomized controlled trial investigating whether self-learning versus instructor-led learning results in the same BLS skills in first year medical students directly after training and four months later.

5.2. Procedures

When participants attend the "Erweiterte Erste Hilfe für Studierende der Humanmedizin" they will receive a short introduction about the study. We will invite all first year students to participate in the study. As the study is voluntarily, participants will need to sign a written informed consent. After that we will randomize the students to either group A or Group B (see figure 1). Group A will train their technical CPR-skills with supervision by a tutor (either general practitioner or medical student, all trained in CPR teaching) and group B will train without supervision. The participants in group B will not be allowed to communicate with each other during the training. The training will take about 40 minutes for each group. Directly after the training each group will be tested and the printed report form from the LSR will be obtained for each participant. In the test the students will perform CPR in a simulated scenario as a first responder. The scenario is: "A male person has collapsed in the hall of the university and you cross by. No other persons are present at the moment." The participant should start CPR as learned in the training. During the CPR a departmental research fellow will observe the study participants and record BLS/AED actions on a scoring sheet.

To avoid struggle with the equipment, each student will be given two minutes to familiarize themselves with the testing manikin and the equipment (an AED). We will record three cycles of two minutes CPR (with five times 30:2 compression : ventilation intervals, as recommended by the current international resuscitation guidelines) (14). During the three cycles an AED will be delivered and the study participant has to apply the AED and deliver a shock – after that the study terminates.

After the BLS/AED competence testing, both groups will continue the rest of their first aid course together and the first part of the study ends. Four months later we will repeated the same scenario over the same time interval and record the same parameters. At the end of the second testing, a short feedback will be provided on the BLS/AED competence and further practice will be provided to the students to improve their CPR competence. From this point forward no further data will be collected

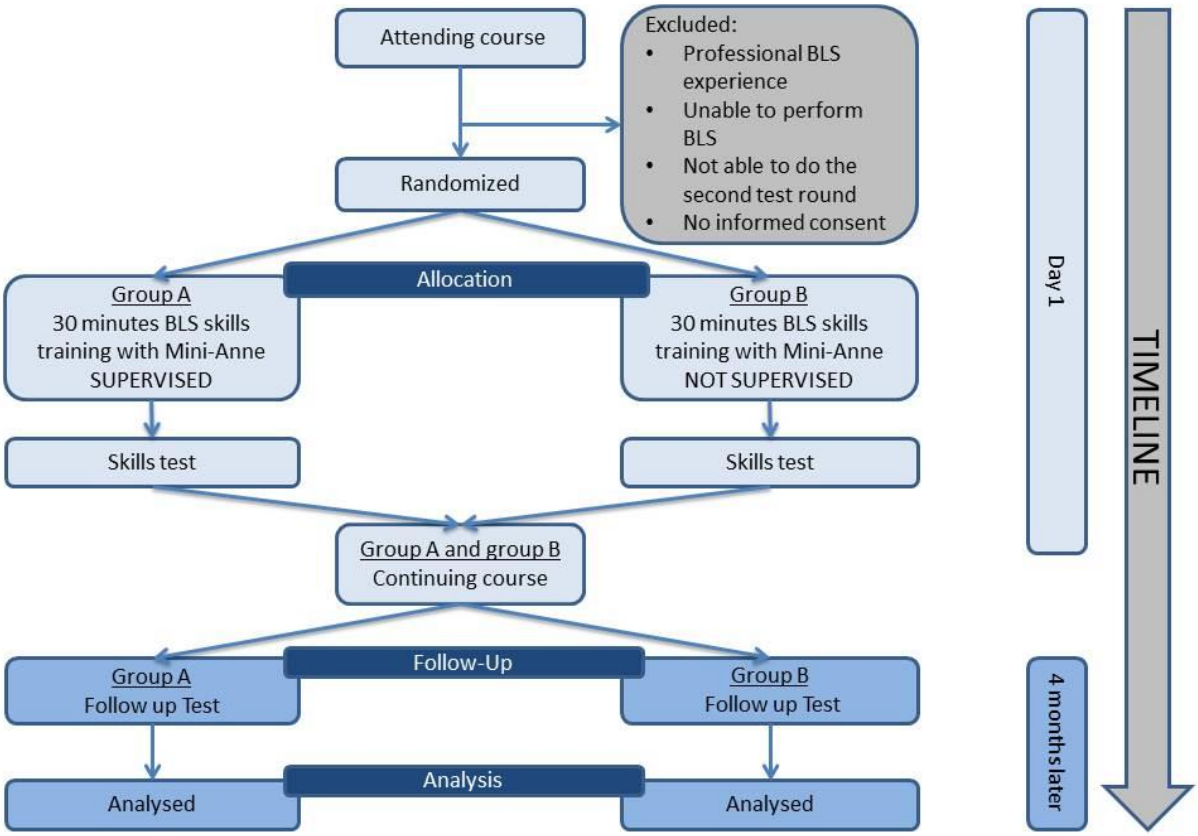


Figure 1: Procedure

6. METHODS OF MINIMISING BIAS

6.1. Randomization

We will use a computerized randomization list (www.randomization.com) using block randomization of 10 to assure proper distribution during each group of students.

6.2. Blinding

There will be no blinding in this study because the participants will realize the difference in the teaching method.

7. PROJECT POPULATION

7.1. Participants

All first year medical students at the University of Bern participating in the course “Erweiterte Erste Hilfe für Studierende der Humanmedizin”.

7.2. Inclusion criteria

First year medical students at the University of Bern participating in the course “Erweiterte Erste Hilfe für Studierende der Humanmedizin” with written informed consent.

7.3. Exclusion criteria

Students with professional BLS-experience, unable to perform BLS, or missing informed consent will be excluded.

7.4. Criteria for withdrawal

The participants can withdraw their consent and leave the study at any time.

8. PROJECT ASSESSMENT

8.1. Assessment of primary outcome

Our primary outcome will be the percentage of correct compressions obtained from the printed report from the LSR.

8.2. Assessment of secondary outcomes

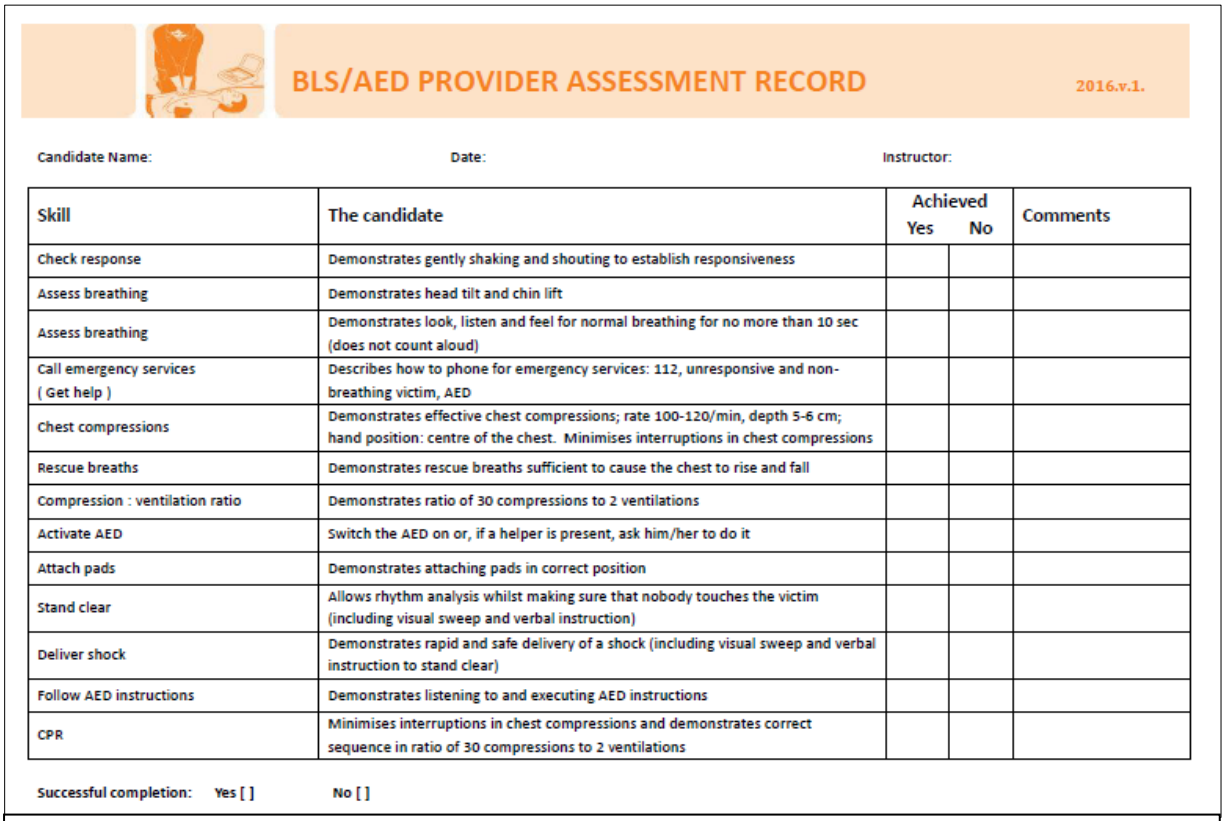
The secondary outcomes are:

- The subcomponents of the printed report from the LSR.
- The score on the BLS/AED provider assessment record.
- Degree of loss of competence after four months for all the primary and secondary parameters.

The printed report from the LSR consists of ventilation volume, number of ventilations per minute, overall ventilation volume, number of ventilations, percentage of correct ventilations, number of ventilations with too much volume, number of ventilations with too little volume, number of ventilations that were too fast, the relation between ventilations and compressions, compression depth, number of compressions per minute, compression frequency, total number of compressions, percentage of correct compressions, number of compressions that were too deep, number of compressions that were too shallow, incorrect hand position, and incorrect decompression. We will record these parameters over the entire testing period. We will look at each parameter individually.

To assess the score on the BLS/AED provider assessment record(13) (fig. 2) during the simulated scenario a departmental research fellow will observe the study participants and record BLS/AED actions on a scoring sheet. Actions recorded are: Check response, assess breathing, call emergency services, chest compressions, rescue breaths, compression : ventilation ratio, activate AED, attach

pads, stand clear, deliver shock, follow AED instructions, and CPR. Time to first chest compression and time to first shock will also be measured.



BLS/AED PROVIDER ASSESSMENT RECORD 2016.v.1.

Candidate Name: Date: Instructor:

Skill	The candidate	Achieved Yes	Achieved No	Comments
Check response	Demonstrates gently shaking and shouting to establish responsiveness			
Assess breathing	Demonstrates head tilt and chin lift			
Assess breathing	Demonstrates look, listen and feel for normal breathing for no more than 10 sec (does not count aloud)			
Call emergency services (Get help)	Describes how to phone for emergency services: 112, unresponsive and non-breathing victim, AED			
Chest compressions	Demonstrates effective chest compressions; rate 100-120/min, depth 5-6 cm; hand position: centre of the chest. Minimises interruptions in chest compressions			
Rescue breaths	Demonstrates rescue breaths sufficient to cause the chest to rise and fall			
Compression : ventilation ratio	Demonstrates ratio of 30 compressions to 2 ventilations			
Activate AED	Switch the AED on or, if a helper is present, ask him/her to do it			
Attach pads	Demonstrates attaching pads in correct position			
Stand clear	Allows rhythm analysis whilst making sure that nobody touches the victim (including visual sweep and verbal instruction)			
Deliver shock	Demonstrates rapid and safe delivery of a shock (including visual sweep and verbal instruction to stand clear)			
Follow AED instructions	Demonstrates listening to and executing AED instructions			
CPR	Minimises interruptions in chest compressions and demonstrates correct sequence in ratio of 30 compressions to 2 ventilations			

Successful completion: Yes [ ] No [ ]

Figure 2: Procedure

By doing the same test four months later, we can measure the loss of competence by comparing the percentage of correct compressions and the subcomponents of the printed report, and compare the score on the BLS/AED provider assessment record.

8.3. Assessment of other study variables

By recording demographic data as age, gender, height and weight, CPR experience (CPR course attendance, real live CPR experience) we will be able to investigate the influence of prior training, gender etc. on competences and decay of competences.

At the end of each course we will ask the participants how competent they feel on a visual analogue scale from 0 (totally incompetent, have no clue what to do) to 100 (totally competent, cannot be done better). The departmental research fellow will also rate the participant on the same scale.

9. STATISTICAL METHODOLOGY

9.1. Determination of Sample Size

Based on a pilot study with 14 participants we calculated a median of 84% correct compressions. The interquartile range was 47% to 93%. We have discussed in the study group that a 20% decrease in percentage of correct compressions would have a clinically impact. Therefore, using a two-sample proportion test with a significance level α of 0.05 and an effect size of 20% (from 64% to 84%) we calculate that it requires 150 subjects to reach a power of 80%. To compensate for drop-outs, we aim to include 200 participants in the study.

9.2. Planned analysis

All data will be summarized for each individual and a summary of all study participants will be computed. Data will be presented as mean (SD) or %.

Parametric data will be compared by a Students-t test, non-parametric by Mann-Whitney-U test. A $p < 0.05$ is considered as statistically significant.

9.3. Data management

The data will be stored in LabKey.

Participants will be coded to assure confidentiality of the personal data.

10. TIMELINE

The BLS course “Erweiterte Erste Hilfe für Studierende der Humanmedizin” takes place in March and April 2017. A manuscript will be ready for submission in winter 2017.

Registration of the study in an international trail register is planned (train.gov).

11. ETHICS

The study has been approved by the Kantonale Ethikkommission Bern with registrationsnumber: Req-2016-00071.

If students can accomplish the same BLS skills and maintain these skills over time, when training BLS by themselves compared to training led by an instructor, there is a foundation for more self-training. When no instructor is needed, the training can take place when it fits the student best; the student only needs a computer and a simple manikin, like the Mini-Anne. Retraining can take place more often because a course does not have to be planned, and salary for the instructor is saved. BLS skills

can be more widespread in the community; lay persons can practice without an advanced manikin or an instructor, leading to an increased chance that people who have a cardiac arrest outside the hospitals receive proper BLS.

Participation in the study is voluntary, and if one chooses not to participate, he/she receives instructor-led training. It has been shown that skills acquired in a self-learning station combining video-instruction with training using voice feedback were not inferior to instructor-led training (11), so we do not consider it a risk for the participants of the self-learning group that they do not take part in the instructor-led group. A study has shown that students taking part in a computer-based learning BLS course performed 60 chest compressions, 12 ventilations and 3 cycles of CPR with a significantly higher accuracy rate than students in an instructor-led group (10), so the participants in the self-learning group can potentially benefit from participating in the study.

There is an excellent risk-benefit ratio in this study. The results from the test will be kept anonymous and it will not have an effect on the students grades. The information gained in this study is generalizable knowledge that can be used in health care systems all over the world. BLS skill training could potentially be more accessible to people in the community and cardiac arrest victims will have a better chance of survival, if more people in the community are able to perform BLS.

12. PUBLICATION

The plan is to submit the resulting manuscript to the peer reviewed journal: Resuscitation, Elsevier.

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