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Effectiveness of teaching basic life support resuscitation using virtual reality

Submission date
10/09/2024

Recruitment status
No longer recruiting

Registration date
23/10/2024

Overall study status
Completed

Last Edited
26/09/2025

Condition category
Other

[_] Prospectively registered
[_] Protocol
[_] Statistical analysis plan
[X] Results
[_] Individual participant data

Plain English summary of protocol
Background and study aims
Teaching methods involving virtual reality (VR) to train cardiopulmonary resuscitation (CPR) gain long-term effectiveness comparable to traditional training, despite the lack of this conclusion being confirmed in short-term evaluation. Modern VR technologies make it possible to achieve optimal first-aid teaching results, minimizing the participation of instructors, and ensuring perfect repetition of procedures, which applies to teaching large groups with a high level of satisfaction. The study aims to determine the effectiveness of resuscitation training conducted using a VR method.

Who can participate?
Healthy volunteer students and lecturers aged 17 years old and over based at the Medical Simulation Center of the University of Siedlce (Poland)

What does the study involve?
Volunteers meeting the inclusion criteria will be randomly assigned to a VR group and a control group to undergo training using the traditional method. Immediately after the training, knowledge levels, satisfaction and skills will be assessed using an examination checklist. After 3 months, the long-term skills of the participants will be assessed, to confirm the effectiveness of basic life support courses using the VR method.

What are the possible benefits and risks of participating?
Benefits and risks not provided at the time of publication.

Where is the study run from?
The Siedlce University of Natural Sciences and Humanities

When is the study starting and how long is it expected to run for?
January 2024 to February 2024

Who is funding the study?
The Siedlce University of Natural Sciences and Humanities

Who is the main contact?
Prof Piotr Leszczynski, piotr.leszczynski@uws.edu.pl

Contact information

Type(s)
Public, Scientific, Principal investigator

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Additional identifiers

Protocol serial number
The University of Siedlce (Poland) No. Resolution

Study information

Scientific Title
Effectiveness of teaching Basic Life Support (BLS) resuscitation using virtual reality – a randomized controlled trial

Study objectives
Teaching methods involving virtual reality to train CPR gain long-term effectiveness comparable to traditional training. Modern VR technologies make it possible to achieve optimal first-aid teaching results, minimizing the participation of instructors, and ensuring perfect repetition of procedures, which applies to teaching large groups with a high level of satisfaction.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 07/12/2023, Committee of Research Ethics for the Siedlce University of Natural Sciences and Humanities (ul. Konarskiego 2, Siedlce, 08-110 , Poland; +48 25 643-19-15; kancelaria@uws.edu.pl), ref: 6/2023

A favorable review by the Research Ethics Committee (Resolution 6/2023). University of Siedlce (Poland)

Primary study design
Interventional

Study design
Randomized controlled trial

Study type(s)
Efficacy

Health condition(s) or problem(s) studied
education

Interventions
The first phase of the study was conducted in November 2023, and the second phase of the study was conducted in January and February 2024. Both phases of the study were carried out at the Center for Medical Simulation at the University of Siedlce (Poland). The study group consisted of 216 students and lecturers. Both knowledge tests, practical tasks and training satisfaction evaluation surveys were evaluated.
The research tool consisted of proprietary pre-test and post-test questionnaires containing 10 questions each, and a course satisfaction evaluation questionnaire consisting of 6 criteria. The knowledge tests included questions on first aid, divided into 5 thematic subcategories (BLS algorithm, airway clearing and assessment of the victim's breathing, calling for help, chest compressions, and rescue breaths). A maximum of 2 points could be earned in each thematic category. To assess practical skills, checklists were constructed taking into account a 0–1-point classification for activities from the BLS algorithm and on a 0-3 point scale for CPR performed. The test subjects worked on a medical simulator with Ambu® CPR Software to record CPR activities in detail. When assessing practical skills, attention was paid to:
1. Safety assessment
2. Yelling for help
3. Assessing the state of consciousness
4. Clearing the airways
5. Calling the emergency medical services
6. Removing clothing from the victim
7. Starting CPR with chest compressions
8. The correct position for performing chest compressions
9. Performing chest compressions with the palm of the hand
10. Unjustified cessation of chest compressions
11. The overall quality of CPR
12. Compression rate
13. Compression depth
14. Chest relaxation

The chest compressions training lasted for 2 minutes, and during the skills evaluation right after the training and three months after the course, the time for performing compressions was 1 minute. The author's questionnaire for evaluating respondents from the training included 6 categories of questions from the areas of satisfaction with the course (Ethical Leadership Scale – ELS), usefulness and utility of the training (Perceived Usefulness – PU), ease of training use (Perceived Ease Of Use – PEOU), technical aspect (Patient Satisfaction Questionnaire – PSQ), substantive quality of the course (Psychological Climate Questionnaire – PCQ), and teaching effectiveness (Personal Teaching Efficacy – PTE) according to a five-point Likert scale.

Stage 1
In the first stage, all respondents completed a pre-test that diagnosed and determined their knowledge of first aid just before the training. They then attended a theoretical lecture on basic resuscitation procedures in adults. After the theoretical part, the subjects were randomly divided into two groups using a dice-throwing method with controlled randomization, as the subjects completed a questionnaire with inclusion criteria before the training, and some of the subjects confirmed absolute contraindications (epilepsy) in the context of receiving training with VR technology. The questionnaire with inclusion criteria also included sociodemographic questions such as age, sex, place of residence and education. The exclusion criteria were age less than 16, lack of consent to the study, partial or no completion of questionnaires and tests, and failure to participate in the indicated form of training full-time. Additional pre-assessment criteria included:
1. Participation in first aid training, including the date of the last such training
2. Using VR technology
3. Nausea/vomiting in the last ten days before the study
4. Pregnancy or suspected pregnancy
5. Having an implanted pacemaker/stimulator/cardioverter or other cardiac assist device
6. Recognized epilepsy
7. Mental disorders
8. Motion sickness

Relative contraindications to participating in training using VR technology included nausea and vomiting, pregnancy, having any heart-action-supporting device, mental disorders, or motion sickness. The only absolute contraindication was epilepsy, which excluded the subject from participating in the VR training (in which case the subject was assigned to the control group). The subjects in Group A were the control group and received training with the traditional method provided by instructors who discussed the course topics, showed the BLS algorithm and conducted practical training on a medical simulator with digital CPR quality assessment. Respondents in Group B took a course using VR technology with special goggles and wearable wireless trackers. At the end of stage one, participants filled out a questionnaire to assess their satisfaction with the training.
Stage 2
In the second stage, which took place 3 months after the completion of stage one, respondents from both groups completed a post-test to assess their long-term level of knowledge after the training and took part in a simulation scene during which their practical skills were assessed according to a prepared checklist. In both stages, the authors chose to teach and evaluate only chest compressions, without performing rescue breaths.

VR technology
Software called "4HELP-VR RESCUE SIMULATOR" was used during the training in Group B. The stand for this study was a space in one of the rooms of the Medical Simulation Center, isolated from external conditions. The equipment included a computer unit with a monitor, a phantom (an adult torso) modified to record the quality of chest compressions, and mobile items such as four HTC VIVE TRACKER sensors (tracking devices to enhance the immersion and experience of virtual reality immersion) and VR goggles (HTC VIVE Headset) with headphones. Two trackers were placed against the simulator's torso, and another two were attached to the subjects' wrists so that the app could track hand movements while allowing the participant to perform effective chest compressions seamlessly. This allowed an accurate measure of the quality of compressions and detected the position of the hands on the simulator's chest.
The task began with mounting two trackers and VR goggles with headsets on the test subject. Once started, the program guided the participant through the calibration process. The calibration process involved following the instructions of a virtual guide - a paramedic who

stayed with the participant throughout the course. The calibration took place in a virtual room, where there was a first aid kit, gloves and a door, after which the participant was carried to the scene.
The incident scene comprised a street where a woman was lying. The virtual instructor informed what to do in the correct order (e.g., look around to make sure it is safe, approach the victim, check for consciousness, tilt the head, and then check breathing). The actions performed on the victim were physically performed on a phantom so that the test subject had the sensation of touching a woman lying on the street visible in the virtual world. The system calibrated the simulator's placement in the real training room with images generated in the VR world. Once that was done, one had to grab the virtual phone and call for help.
After calling for help, it was necessary to start CPR consisting solely of chest compressions. They were also performed on a real medical simulator, which was transformed into a realistic-looking victim in the virtual world. Chest compressions were performed for a period set by the examiner (there was complete freedom in the duration of compressions recorded). The time set for performing compressions during training was 2 minutes.
While performing them, the participant in the VR world saw a manometer showing the rate of compressions and a potentiometer indicating the depth of compressions. The visual feedback also provided arrow information about the need to increase the depth of compressions and relax the chest. The respondent also heard guidance from the virtual instructor, who continuously adjusted the rate, depth, or chest relaxation during CPR. The HERO 1 Sensor used (a proximity device adapted to the design of various medical simulators on the market that collects information about the quality of the simulator's chest compressions being conducted) allowed for the ongoing digital transmission of data from the simulator to the system.
As the real-life instructor finished measuring the quality of CPR, the participant saw an ambulance approaching, and a board with detailed information on the quality of chest compressions was displayed after a while. Some of the data showed included:
1. Overall resuscitation outcome [%]
2. Compression depth [% and mean in mm]
3. Compression rate [% and mean /min]
4. The total number of chest compressions performed
5. Quality of correctly performed chest relaxations [%]
6. Quality of correctly achieved compression depth [%]

Intervention Type
Behavioural

Primary outcome(s)
Knowledge level assessment measured on a point and percentage scale before and immediately after the training

Key secondary outcome(s)
1. Satisfaction level assessment measured on a Likert scale immediately after the training
2. Skill level assessment - measured using the Objective Structured Clinical Examination (OSCE) checklist immediately after the training and 3 months later

Completion date
28/02/2024

Eligibility

Key inclusion criteria

1. Consent to participate in the study
2. Participation in all stages
3. No health contraindications

Participant type(s)
Healthy volunteer, Employee, Learner/student

Healthy volunteers allowed
No

Age group
Child

Lower age limit
17 Years

Sex
All

Total final enrolment
216

Key exclusion criteria
1. Aged less than 16 years old
2. Lack of consent to the study
3. Partial or no completion of questionnaires and tests
4. Failure to participate in the indicated form of training full-time

Date of first enrolment
01/01/2024

Date of final enrolment
04/01/2024

Locations

Countries of recruitment
Poland

Study participating centre
Medical Simulation Center
Siedlce (Poland), Bema 1a Str.
Siedlce
Poland
08-110

Sponsor information

Organisation
Siedlce University of Natural Sciences and Humanities

ROR
https://ror.org/01wkb9987

Funder(s)

Funder type
University/education

Funder Name
Uniwersytet Przyrodniczo-Humanistyczny w Siedlcach

Alternative Name(s)
The Siedlce University of Natural Sciences and Humanities, University of Natural Sciences and Humanities in Siedlce, Siedlce University of Natural Sciences and Humanities, Естественно-Гуманитарный Университет в г. Седльце, Uniwersytetu Przyrodniczo-Humanistycznego (UPH) w Siedlcach, UPH

Funding Body Type
Government organisation

Funding Body Subtype
Universities (academic only)

Location
Poland

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated during and/or analysed during the current study will be stored in a publically available repository. Participant data will be shared once they have been fully anonymised.

IPD sharing plan summary
Stored in publicly available repository

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		25/09/2025	26/09/2025	Yes	No