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RESEARCH ARTICLE

The effectiveness of using medical students for training high school students in cardiopulmonary resuscitation

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Introduction: Training for cardiopulmonary resuscitation is a very important topic for society, trainers and researchers. However it is not yet established who should be trained and by whom nor how the training programmes should be accomplished. We developed a study to evaluate an existing programme where medical students train high school students in cardiopulmonary resuscitation using instrumented mannequins to teach and collect performance data.
Method: The students of four randomly selected high school classes were trained by four randomly selected medical students and were evaluated by an independent evaluator. The level of knowledge provided and the level of technical skills acquired were analysed.
Results: One hour of lecturing was enough to increase the mean of correct answers from 39.52% to 78.48% when we tested knowledge. Testing for skills retention we found that that 92.75% of trained students taped the shoulder; 95.65% asked loudly "Are you all right?" at the right moment; 97.1% shouted for help at the right moment, the entire group remembered to check the breathing at the right moment, and 92.75% executed a correct head tilt chin lift manoeuvre; 86.9% remembered to call 112 at the right moment. Automatic recordings showed that mean flow fraction was 80.74%, mean no flow time was 18.9 seconds, mean frequency of chest compressions was 134.7/min and mean compression depth was 39.06 mm.
Conclusions: The results showed that high school students achieved a good level of knowledge and acceptable cardiopulmonary resuscitation skills when trained by medical students.

Keywords: effectiveness, cardiopulmonary resuscitation, training, high school students, medical students

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Introduction

Training high school students in cardiopulmonary resuscitation (CPR) is an attractive idea [1]. Raising interest regarding CPR at a young age, when learning is the main activity in a person's life, seems advantageous [2]. Also, it may be of use to teach these skills at an age that significantly increases their exposure to public places. A survey showed that an average teenager spends 58 hours every month in malls [3] – the third most frequent location of cardiorespiratory arrest in public places [4]. Many states from the United States of America have already implemented BLS training as part of the high school students' education. Yet, it is unclear who should run these training sessions. Trainers with high levels of competence are rarely available and are expensive. The use of trainers with a lower competency level is not sustained by evidence.

In our hometown we developed a volunteer based programme to train high school students in basic CPR skills. The trainers are medical students, with basic CPR training completed during the "Medical First Aid" discipline, mandatory in the first year of medical school. All the volunteers received basic training in theoretical teaching and practical training of CPR to others, offered by a member of the Anaesthesia and Intensive Care Department experienced in "train the trainers" programs. So far, in three years of running the programme, we have trained more than 1300 high school students.

We present an evaluation of the effectiveness of this programme with medical students used as trainers for BLS training of first year high school students, aged around 15 years.

Method

After approval from the local educational authority (Cluj County School Inspectorate), we obtained the approval from both the University of Medicine and Pharmacy Târgu Mureș Ethical Committee and University of Medicine and Pharmacy "Iuliu Haţieganu" Cluj Napoca Ethical Committee. The principal of the high school and the class masters of each class were informed and approved the study. The high school students were informed about the study, and informed consent was requested to be signed by each of them and by at least one of their parents. We randomly assigned four different students as trainers to four randomly selected high school classes. We tested the preliminary theoretical knowledge of the group by asking them to complete a multiple choice question (MCQ) questionnaire. Af-

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ter the preliminary test, the high school students received one hour standardised theoretical lecture with same power point slide show, sustained by one of the four designated medical student trainers. One week later, the same trainer offered to the same high school students a practical training session using the Little Anne® CPR training mannequins (Laerdal, Norway). The training session was focused on the correct steps of diagnosing cardiorespiratory arrest, activating emergency response and providing correct CPR (thoracic compressions only). The sessions were conceived according to the European Resuscitation Council Guidelines. Enough time was given until both the trainer and the trainee were satisfied with the trainees' performance. At the end of the training, the high school students were told that in one to four weeks after the training they would be evaluated regarding their theoretical knowledge and practical skills in providing correct CPR. They were also asked not to prepare supplementary information for the tests. Two weeks after the practical training an independent evaluator, evaluated the high school students. Theoretical knowledge was tested by an MCQ test, different from the initial one, and the practical skills were evaluated with the help of a Resusci Anne® (Laerdal, Norway) mannequin with a SkillReporter™ (Laerdal, Norway) device attached. The practical skills that were not automatically recorded were noted on paper by the evaluator. The data was statistically analysed with the help of GraphPad Prism® 6 software.

Results

The initial study group consisted of 97 students from the four randomly selected classes, who returned the informed consent signed, and agreed to be included in the study. All of them answered the preliminary MCQ test and received practical and theoretical training. Because we did not announce the exact date and time of the evaluation, only 64 students were available to answer the final MCQ test, and 69 were present and completed the practical evaluation at the end of the training, the rest of them being involved in other activities that they could not miss.

From the preliminary MCQ test we obtained a mean of 39.52% correct answers (lowest value 13.33%, highest value 80%) with a SD of 12.37%, and with p=0.3664 on the D'Agostino & Pearson normality test, showing a normal distribution. These data showed a low level of previous knowledge of CPR in our study group. The results of the final MCQ test showed an increased mean to 78.48% correct answers (minimum 54.17%, maximum 93.75%) with a SD of 8.07, and p=0.0214 on D'Agostino & Pearson normality test, suggesting increased effectiveness of the lectures.

Regarding the evaluation of the practical skills, we recorded 120 seconds of CPR activity for each evaluated trainee. We analysed two data sets: one recorded by the evaluator - data that could be considered more or less subjective and we used the same evaluator for all the students to reduce bias, and one automatically recorded by the SkillReporter™ device, representing objective data.

The first data set followed the correct steps in diagnosing cardiac arrest: shoulder taping, asking loudly: "Are you all right?", shouting for help, checking for the normal breathing for ten seconds, correct head extension, calling 112 before starting CPR. The actions were noted with "done" or "didn't do" by the evaluator. The evaluator checked "didn't do" even if the trainee performed the step wrongly or in the wrong order. The results of the study group showed that 92.75% taped the shoulder; 95.65% asked loudly "Are you all right?" at the right moment; 97.1% shouted for help at the right moment, the entire group remembered to check the breathing at the right moment, and 92.75% executed a correct head tilt chin lift manoeuvre; 86.9% remembered to call 112 at the right moment, and the rest of them remembered in the first minute after initiating chest compressions.

From the automatic recordings we analysed: the flow fraction, the no flow time, the mean frequency of compressions, and the mean compressions depth. The mean flow fraction recordings showed a mean of 80.74% (lowest value 33%, highest value 94%) with a SD of 12.2% and p=0.0001 on D'Agostino & Pearson normality test. The mean no flow time was 18.9 seconds (minimum 0 seconds, maximum 49 seconds) with a SD of 10.08 seconds and p=0.0013 on D'Agostino &Pearson normality test. The mean frequency of chest compressions was 134.7/min (minimum 102/min, and maximum 166/min), with SD 14.09/min and p=0.9897 on the D'Agostino & Pearson normality test. Mean compression depth was 39.06 mm (minimum 16 mm, maximum 55 mm) with SD 8.16 mm and p=0.34 on D'Agostino & Pearson normality test.

Discussions

Chances that a high school student will witness a cardiorespiratory arrest are estimated to be between 0.18 and 0.19 in every 100,000 persons/ year. These chances increase during college to more than 4.5 in every 100,000 persons/year [5]. We believe that training CPR in this age group is important for society and is effective in making them aware of the importance of training in this domain. The main problem is that instructor availability is low and it has not yet been established who should be the teachers for increased efficiency [6]. Medical students have been previously used by other authors to teach their younger colleagues in medical school about CPR [7].

Our data demonstrates good knowledge retention when medical student were lecturers in CPR training sessions of high school students. The high school students were asked not to prepare supplementary information for the upcoming evaluation, and they found out about it only a few minutes before, so we may conclude that one hour of lecturing was enough to increase the mean of correct answers from 39.52% to 78.48%.

Also the results of the practical evaluation are in acceptable ranges; both subjective and objective data show good skills in the trained group. We consider that one point

worthy of discussion and maybe worth improving in our program is the frequency of compressions. As clinicians, we tend to believe that frequencies closer to 80-120/min intervals may be more effective in providing a better blood flow, even though many training programs consider that "push hard, push fast" is an acceptable approach when training laypersons. We would like to underline that none of the study group students pushed less than 100/min. We also consider that the mean compression depth is acceptable in our study, as long as the current recommendation to push 5 to 6 cm was not proven to be superior in terms of survival to the older recommendation to push 38 to 51 mm. Also we found no studies comparing the compressions depth in mannequins versus human victims of cardiac arrest.

Conclusion

We believe that our data demonstrates that medical students may be a reliable alternative as trainers in CPR to high school students. Medical students are well known for their availability and eagerness in volunteering. They are usually groups of young enthusiastic intellectuals with training skills, or willing to develop these kinds of skills. These qualities should be better used by society. We suggest that medical students might be the answer to the currently "hot question" in CPR training: "who should train CPR to the youngest?"

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Conflict of interest

None to declare.

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