Revista da Escola de Enfermagem da USP
ISSN: 0080-6234
reeusp@usp.br
Universidade de São Paulo
Brasil

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Ressuscitação cardiopulmonar com a utilização do desfibrilador externo semi-automático: avaliação do processo ensino-aprendizagem
Revista da Escola de Enfermagem da USP, vol. 42, núm. 3, septiembre, 2008, pp. 532-358
Universidade de São Paulo
São Paulo, Brasil

ORIGINAL ARTICLE

# Cardiopulmonary resuscitation with semi-automated external defibrillator: assessment of the teaching-learning process

RESSUSCITAÇÃO CARDIOPULMONAR COM A UTILIZAÇÃO DO DESFIBRILADOR EXTERNO SEMI-AUTOMÁTICO: AVALIAÇÃO DO PROCESSO ENSINO-APRENDIZAGEM

RESUCITADOR CARDIOPULMONAR CON UTILIZACIÓN DEL DISFIBRILADOR EXTERNO SEMIAUTOMÁTICO: EVALUACIÓN DEL PROCESO ENSEÑANZA-APRENDIZAJE

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**ABSTRACT**

Studies demonstrate that, for every minute delayed on defibrillating a heart arrest patient, survival chances decrease by 10%, and that the same chances of survival are 98% effective when it is employed within 30 seconds. While attending a heart arrest patient, it is crucial that the use of external semi-automated defibrillator (AED) is included in the training. The purpose of the present study is to compare Psychomotor Ability and the Theoretical Knowledge of lay people on cardiopulmonary resuscitation (CPR) using AED, before and after training. This sample was composed of 40 administrative workers of a public institution that were trained on CPR technique using EAD, as an experiment. The significantly higher scores in the assessment instrument items of Psychomotor Ability and Theoretical Knowledge, after training, indicates that the participants have presented improvements in their performances.

**KEY WORDS**

Electric countershock.
Heart arrest.
Cardiopulmonary resuscitation.
Teaching.
Learning.

**RESUMO**

Estudos demonstram que a sobrevida após uma parada cardíaca diminui 10% para cada minuto de atraso na desfibrilação, e que a taxa de sobrevivência é de 98% quando ela é conseguida em 30 segundos. No atendimento de uma parada cardíaca, é primordial que seja incluído no treinamento a utilização dos desfibriladores externos semi-automáticos (DEA). O objetivo deste estudo foi comparar a Habilidade Psicomotora e o Conhecimento Teórico de leigos na técnica da ressuscitação cardiopulmonar (RCP) utilizando o DEA, antes e após treinamento. A amostra constituiu-se de 40 funcionários administrativos de uma instituição pública que receberam treinamento da técnica da RCP, utilizando o DEA, em laboratório. O aumento significativo de acertos nos itens do instrumento de avaliação da Habilidade Psicomotora e do Conhecimento Teórico, após o treinamento, indica que houve melhora no desempenho dos participantes.

**DESCRITORES**

Cardioversão elétrica.
Parada cardíaca.
Ressuscitação cardiopulmonar.
Ensino.
Aprendizagem.

**RESUMEN**

Los estudios demuestran que la sobrevida después de un paro cardíaco disminuye el 10% por cada minuto de atraso en la desfibrilación y que la tasa de supervivencia es del 98% cuando se consigue en 30 segundos. En la atención de un paro cardíaco es primordial que se incluya en la capacitación la utilización de los desfibriladores externos semi-automáticos (DEA). El objetivo de este estudio fue comparar la Habilidad Psicomotora y el Conocimiento Teórico de legos en la técnica de la resucitación cardiopulmonar (RCP) utilizando el DEA, antes y después de la capacitación. La muestra estuvo formada por 40 empleados administrativos de una institución pública que recibieron capitación en la técnica de RCP, utilizando el DEA, en laboratorio. El aumento significativo de aciertos en los ítems del instrumento de evaluación de la habilidad Psicomotora y del Conocimiento teórico, después de la capacitación, indica que hubo mejora en el desempeño de los participantes para realizar la RCP con el uso del DEA.

**DESCRIPTORES**

Cardioversión eléctrica.
Paro cardíaco.
Resucitación cardiopulmonar.
Enseñanza.
Aprendizaje.

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Received: 05/31/2006
Approved: 11/05/2007

OnLine Portuguese / English: www.scielo.br/reeusp

## INTRODUCTION

Considering that a large number of heart arrests occur at non-hospital environments, it is fundamental for the lay population to be acquainted with the employment of resuscitation techniques and priorities[1]. Common citizen involvement, under these circumstances, is the only way to reverse the current healthcare reality in developing countries as Brazil.

Currently, the new International Guidelines on Emergency and Resuscitation, the International Liaison Committee on Resuscitation (ILCOR), the American Heart Association (AHA) committee and the European Resuscitation Council (ERC) consider defibrillation to be a basic life support procedure, inside and outside hospital environment[2]. Basic Life Support (BLS), as it is, aims at providing immediate attention on emergency situations, generally a cardiopulmonary arrest.

These guidelines are sheltered under the etiology of these cardiac emergencies, since the main causes for adult heart arrest is ventricular fibrillation (VF), which tends to evolve to asystole within minutes. The only efficient treatment for these cases is for electric defibrillation to be employed as fast as possible, considering that survival probabilities for an individual with heart arrest by fibrillation decrease between 7 to 10% per minute[1].

Considering that a large number of heart arrests occur at non-hospital environments, it is fundamental for the lay population to be acquainted with the employment of resuscitation techniques and priorities.

Since 1992, the AHA developed a concept of life expectancy that predicts an orderly and committed series of procedures while attending a cardiopulmonary arrest patient[2-3]. The survival chain is made of four links, and in a successful CPR, every one of them is important. It includes: fast access, aiming at acknowledgement and immediate communication of the occurrence in order to obtain help; a fast cardiopulmonary resuscitation (CPR) – in other words, airway opening, ventilation and blood circulation should all occur as soon as possible; fast defibrillation, identifying and treating VF, and finally, the employment of advanced life support (ALS) techniques, which aim at controlling airways and appropriate medication to the diagnosed cardiac rhythm.

Fast defibrillation is the link in the Survival Chain that holds the best probabilities of improving survival rates. The time gap between loss of consciousness and defibrillation is the most important variable for a successful reversion of VF to a normal rhythm [4-5].

When automated defibrillators (AED) were introduced, there was a need to establish a further link between lay people and "paramedics" to perform early defibrillation, and consequently to increase survival rates. These defibrillators, portable and much lighter, enable emergency staff (police, firefighters, healthcare students and ambulance staff,) with neither advanced training nor ability to diagnose arrhythmias, to intervene in VF cases. Many researchers hope that, as its use is widely spread, AEDs, in the future, will be made available at public and private places related to the possible presence of individuals at risk[2,4-6].

Public health holds the responsibility for the initiative to bring AEDs to lay people in the community, and also for the necessary training. In American communities, the use of AEDs by lay rescuers has provided extraordinary survival rates, up to 49%[7]. This initiative may represent the greatest single progress on sudden heart arrest treatment since the development of CPR[5].

Current early defibrillation policies foresee the installation of AEDs, broadly available and within the reach of trained operators. Moreover, excellent results have been observed in studies presenting high rates of successful resuscitation on CPR victims, in American casinos and in the Boston airport[8-9].

From this concept, results in movements have already been observed in developed countries, such as in the United States of America, where all States have passed legislation that encourage the use of AED by lay people. This Law, denominated Cardiac Arrest Survival Law, offers judicial protection to lay rescuers that use the AED and to companies or other entities or other individuals that buy this type of equipment for public access to defibrillation[10].

The facts pointed out above demonstrate the importance of educating the lay population about the recognition of cardiac emergencies and the procedures to be performed in such emergencies. Under this point of view, it is attributed to the nurse the duty of the teaching-learning process, focused on lay users, as they receive training on cardiac arrest using AED. This process involves complex actions aiming at the development of the apprentice in the cognitive area and also in the psychomotor and emotional areas[11-12].

Under the scientific poverty context pertaining this area, it is highlighted that the first national article to emphasize the use of defibrillators in basic life support, while practicing sports, reminds the importance of the participation of both the lay population and physicians when attending heart arrest victims; however, it does not mention other professionals in the healthcare area[13]. Moreover, the lack of studies on the use of defibrillators reaches Nursing itself, on a national sphere, which holds a scientific record that lacks research.

Corroborating the fact, in foreign lands, a study on literature review about Psychomotor Ability and CPR Theoretical Knowledge retention, after training, presented as a

master's degree dissertation at the Newham University Hospital in London, revealed that studies about this theme written by nurses are still very rare[14].

Holding the observed progress in CPR in countries as the United States of America as convincing and, since the precarious status of public health in Brazil does not allow initiatives to promote campaigns for mass community training and availability of AEDs in public places, the initiative to analyze an optimization strategy of the teaching-learning process of CPR technique using AED was foreseen.

## OBJECTIVES

Comparing Psychomotor Ability and the Theoretical Knowledge of lay people on cardiopulmonary resuscitation (CPR) technique using AED, before and after training.

## METHOD

The study was performed at *Centro de Formação e Aperfeiçoamento em Ciências da Saúde* (CEFACS), where the Cardiovascular Emergency simulation and training Laboratory of a Specialized Public Institution of the city of São Paulo is located, after being approved by the Ethics Committee and authorized by the institution (No. 402/2004/CEP/EEUSP).

Data collection was performed by researchers from October 18th to November 10th, 2004, after standardization and training. The administrative staff of CEFACS was invited. Casuistry was composed by those who met the following inclusion criteria: availability, consent on participating as sample, no knowledge and/or previous manipulation of AED. The institution's interest on training all employees that have direct contact with patients is highlighted, whether healthcare professionals or not.

In order to evaluate participants' performance on heart arrest victims, using a mannequin (an anatomic model) and the AED was considered as **Psychomotor Ability**. This evaluation, an instrument denominated *Psychomotor Ability Assessment* was used with 17 items as a check-list. And as **Theoretical Knowledge**, answers to the 10 practical-theoretical questions (multiple-choice test) by means of an instrument denominated as *Theoretical Knowledge assessment* were considered. The questions were related to the victim's evaluation; the links of the Survival Chain the usage sequence of AED, inadequate usage of the AED and safety procedures; the maintenance of the victim until the arrival of the Emergency Medical Service.

Data collection was performed in two phases, named 1st phase and 2nd phase, before and after training, respectively. For Psychomotor Ability assessment, a simulation of a heart arrest victim attendance was performed in the Simulation and Training Laboratory.

In the 1st phase, participants answered the theoretical questions for the Theoretical Knowledge Assessment. Afterwards, a CPR procedure was performed on the victim with no previous training, in a site that had been prepared for this purpose. At his moment, the Psychomotor Ability[10] Assessment of the participants was performed, using an instrument for this purpose.

At the end of the 1st phase, an expositive class and practical training was given about CPR using AED. At this point, the authors oriented and clarified all doubts related to the knowledge test questions and to the performance of CPR on victims. After the training, participants were, once again, evaluated in the application of the same instruments from the 1st phase. This phase was named the 2nd phase – in other words, the performance (Ability) reevaluation and Theoretical knowledge after the training.

It is important to point out that the AED was offered both in the 1st and 2nd phases, even when participants did not require it, and, from this moment, the time spent on the 1st shock/defibrillation was measured.

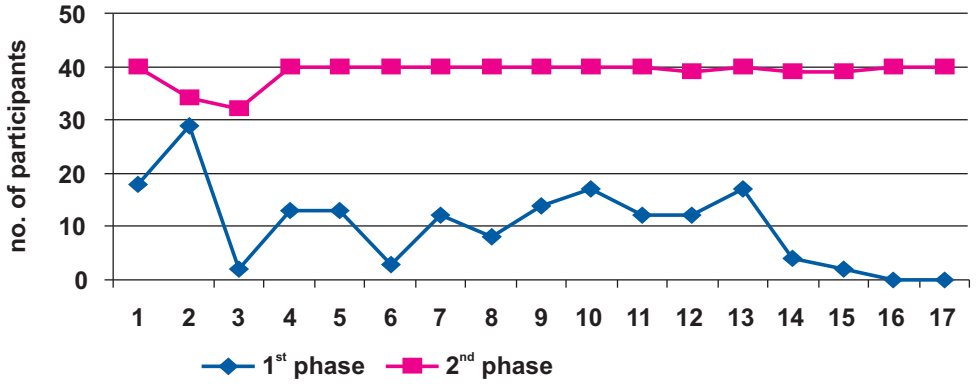
Data were analyzed by means of the paired *t* test. Significance level was of $\alpha = 5\%$.

## RESULTS AND DISCUSSION

The sample was constituted by 40 participants, mostly female (72.5%), young adults, with half of them (50%) being single. Considering education, the majority (55.0%) of participants held a high school degree, followed by 40.0% of participants holding a college degree. Regarding professional position, 26 (65.0%) were administrative assistants, followed by 8 (20.0%) security guards, and 6 (15.0%) housekeeping and planning assistants.

### *Psychomotor Ability Assessment* (execution)

Results of the participants' performance when attending CPR victims are presented in Figure 1.




**LABEL:** 1. Determine response absence; 2. Call for help; 3. Require the AED; 4. Open airways; 5. Check breathing; 6. Make 2 slow breathings causing thoracic expansion; 7. Check carotid pulse and other signs of circulation; 8. Begin thoracic compressions, if pulse is absent; 9. Place AED next to the victim (next to the left ear); 10. Turn on AED; 11. Apply auto-adhesive pads into the correct position (sternum and apex); 12. Make sure the victim is cleared; 13. Apply shock according to AED indications; 14. Check carotid pulse and other circulation signs until the SAVC arrival; 15. Restart thoracic compressions, until the AED requires a new shock; 16. Maintain breathing control and circulation signs until the SAVC arrival; 17. Leave the victim at a recovery position keeping the AED applied, if there is no trauma. (Instrument taken and adapted from the American Heart Association)

**Figure 1 -** Distribution of participants that performed the Psychomotor Ability Evaluation itens correctly, in both phases - São Paulo - 2004

Figure 1 shows that in the 1st phase, the correct execution of items occurred under relative various frequencies, going from 0.0% (*Continue to control breathing and circulation signs until the arrival of advanced support* and *Place victim on a recovery position with the AED applied*) to 72.5% (*Ask for help*).

**Table 1 -** Average, Minimum/Maximum, Standard Deviation, Average standard error, total correct performances in the Ability Assessment, in both phases, and paired *t* test results - São Paulo - 2004

| Variable | Average | Min/Max | Standard deviation | Standard Error Average | P |
|---|---|---|---|---|---|
| 1st phase | 4.800 | 1-7 | 2.493 | 0.394 | |
| 2nd phase | 16.575 | 4-10 | 0.958 | 0.151 | < 0.001 |

According to Table 1, significant differences can be observed on the total averages of correct performances in the Ability Assessment, before (1st phase) and after (2nd phase) training (p<0.001.)

A significant improvement from the 1st phase to the 2nd phase was observed in all sequence items of the attendance in the Psychomotor Ability Assessment. On the 2nd phase, an increase on the total scores was noticed, translating the performance improvement (Execution) of participants after training. The main point that called our attention was that, on this phase, even after training, items 2 (*ask for help*) and 3 (*Require the AED*) were still performed incorrectly, 6 (15.0%) and 8 (20.0%), respectively.

A similar study analyzed the CPR Psychomotor Ability teaching-learning process on 76 nursing graduation students. On this study, the *Ask for help* item was also not executed by 15.8% of students, after training[11]. Moreover, in another research where precocious defibrillation executed by nurses was studied, one of the most frequent errors noticed was not calling for help and not requiring the defibrillator, by 69.1% of nurses[7].

It is also important to point out that some participants, after training, thought that requiring for specialized assistance was irrelevant. The fact was evidenced by the analysis of item 2 ("Ask for Help") on the 2nd phase, one of the items in which the lowest scores were obtained, since they felt able to perform CPR without considering the fact that they needed help to continue the treatment. However, when considering the score rates on the other items, except for item 3, the simulation laboratory training can be inferred to provide more confidence and trust to participants, which may have been a learning motivation source.

The experience of participating on a real situation is not equivalent to training or laboratory practice. Training

may increase self-confidence; however, it is important to notice that the apparent sensation caused by the laboratory experience may be an illusion. However, the ability to capture details, while contacting the victim, to integrate sensorial information with practical theoretical recognition is essentially individual, provoking decision-making of: what, when and how to do it, something that cannot be transfered[11].

The time spent in AED usage, during both phases, is represented in Figure 2.

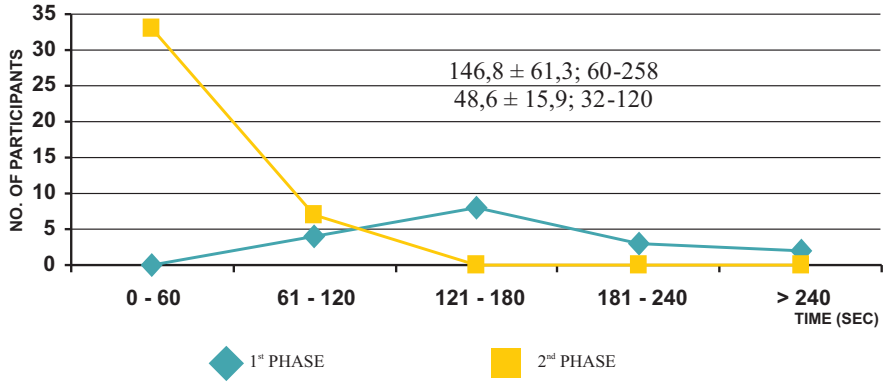



**Figure 2** – Participants' distribution according to the time spent on the delivery of AED and the defibrillation application, in both phases – São Paulo - 2004

Figure 2 illustrates the average time spent (measured from the time the AED was delivered to the time of the first defibrillation/shock) of 48.6 seconds, after training. In the 1st phase, the time obtained was of 146.76 seconds. Therefore, an improvement in the 2nd phase (after training) was noticed when relating to the 1st phase (before training.) No similar studies were found to counter these results in national literature.

In a research done with physiotherapy nurses[15], before previous training, they were able to use the AED , performing a shock within 40-196 seconds, and after training, this time was reduced to 41-61 seconds. Moreover, studies performed with *paramedics* showed that in 94% of occasions, the time spent, from cardio-respiratory arrest recognition to AED shock, was less than 90 seconds after training[16]. Similar data were observed when analyzing the time spent by nursing students during a CPR with AED. The average time spent was also noticed as lower than 90 seconds, after training[17]. Data from international literature corroborate those obtained in this research.

In this present study, 17 (42.5%) used the AED in the 1st phase and were able to apply defibrillation, with a few errors. Among them, items like "Place the pads with the AED turned off", *Incorrect positioning of auto-adhesive pads*, *not clearing people around the victim* and *remove pads after the first shock.* Some authors[18] revealed that nurses and physiotherapists were not able to place the pads correctly (53%) or to follow the safety procedures correctly (67%), before training, and that afterwards, each of them placed the pads correctly and followed the defibrillation safety procedures correctly, as observed by this study.

While training, the participants could exercise as much as they thought necessary, until they felt confident, where the minimum times in training was 1 and the maximum were 5, with an average of 2.2 ± 0.82 times.

### *Theoretical Knowledge Assessment (test)*

Figure 3 demonstrates the Theoretical Knowledge of participants in both phases of the research.

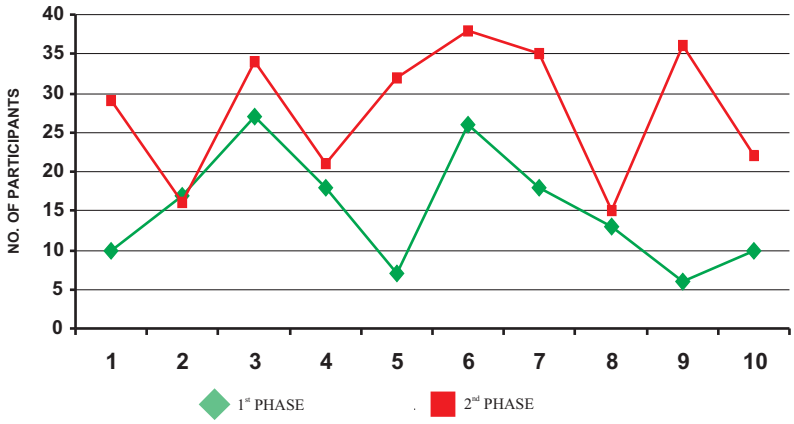



**Figure 3** - Demonstrates the Theoretical Knowledge of participants in both phases of the research - São Paulo - 2004

An improvement in the reponses to the Theoretical Knowledge Assessment from the 1st phase to the 2nd phase was observed, i. e., before and after training, as shown in Figure 3. On questions 5 and 9, *Safety Procedures* using AED, the frequency of correct scores in the 1st phase was low 7 (17.5%) and 6 (15.0%), respectively. Question 3 and 6 about *Evaluating a cardio-respiratory arrest victim* obtained most of correct scores in the 1st phase (before training), respectivelly 27 (67.5%) and 26 (65.0%). Yet, on the 2nd phase (after training), the highest scores were verified in questions 6 and 9, respectively, 38 (95.0%) and 36 (90.0%). It is important to note that question 2 was the one with less correct answers in the 2nd phase, that is, after training, than in the 1st phase (before training). We believe that results were due to terminology and concept (question 2 *links of the Survival Chain*) did not interest and/or were not remembered since they are realtively new in our area.

**Table 2** - Average, Minimum/Maximum, Standard Deviation, Average standard error, total correct performances in the Knowledge Assessment, in both phases, and paired *t* test results - São Paulo - 2004

| Variable | Average | Min/Max | Standard deviation | Standard Error Average | P |
|---|---|---|---|---|---|
| 1st phase | 3.800 | 1-7 | 1.58 | 0.25 | < 0.001 |
| 2nd phase | 6.975 | 4-10 | 1.49 | 0.23 | |

Table 2 shows a significant difference between the average of the total correct answers, before and after training on Theoretical Knowledge Assessment (p<0.001.) On average, improvement was by three or more points.

Results on the written test on nurses about CPR enabled the observation of more frequent errors (52.8%) related to questions about the use of the automated defibrillator. These results were related to the fact that defibrillation was not performed by nurses in Brazil[7].

The research analyzing the Psychomotor Ability teaching-learning process during emergency procedures and CPR techniques by nursing graduation students verified a significant improvement on students' performance, after practice, related to the Theoretical Knowledge[11]. In a similar study, the nursing team, when evaluated, showed significant improvements on the nurses' Knowledge from the 1st phase (before training) to the 2nd phase (after training) of this study.

Improvement of the training level of the lay population and of health professionals results on the reduction of mortality and morbidity by cardiovascular diseases. This reduction provides improvement on life expectation with better quality[1]. Therefore, the most recent recommendations favoring early defibrillation highlight that defibrillators should be made available to whoever holds a higher probability to witness or to identify VF victims early[2,3-5,19].

Synthesizing, training lay people in adequately prepared laboratories can surely enable them to perform CPR emergency treatment using AED, particularly due to the observations of improvement on the time of performance until the first shock/defibrillation, which is essential for the victim's prognostic improvement. Although these facts are presented as true and hold the encouragement of the most serious international organs involved, implementing the present strategy, on a large scale, is strictly connected to the governmental authorities interests, which are, for the time being, much limited.

## CONCLUSION

The present study has reached the conclusion that the significant increase of correct answers over the assessment instrument items of Psychomotor Ability and Theoretical Knowledge, after training, indicates that participants presented improvements on their performance when executing CPR using AED.

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