



UPDATE IN INTENSIVE CARE: NOVELTIES IN RESUSCITATION

Novelties in resuscitation training methods[☆]

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Abstract The importance of cardiac arrest as a health problem makes training in resuscitation a topic of great interest. It is necessary to enhance resuscitation training for all citizens, starting in schools and institutes, targeting teachers and nurses for training, to in turn become future trainers. The model of short courses with video-instruction and the use of mannequins is useful for the dissemination of resuscitation techniques. Liberalization of the use of automated external defibrillators (AED) and reduction of the training requirements in basic life support and AED for those non-health professionals who can use them seem appropriate. Training must be improved in schools of medicine and nursing schools at undergraduate level. Health professionals should be trained according to their needs, with emphasis on non-technical skills such as leadership and teamwork. The model based on the use of trainers and low-fidelity mannequins remains a basic and fundamental element in training. Training through performance evaluation is a technique that should be implemented in all areas where cases of cardiac arrest are seen and the healthcare team has intervened. Simulation appears to be defined as the current and future modality for training in various medical areas, including of course the important field of resuscitation. Lastly, research in resuscitation training should be considered an example of translational science, where rigorous studies of skill acquisition with outcome measures serve to transfer the results to the clinical environment for analysis of their impact upon patient care. © 2011 Elsevier España, S.L. and SEMICYUC. All rights reserved.

PALABRAS CLAVE

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Resucitación;
Formación;
Métodos de formación

Novedades en métodos formativos en resucitación

Resumen La importancia de la parada cardiaca como problema sanitario hace que la formación en las técnicas de resucitación constituya un tema de gran interés. Es necesario potenciar la formación en resucitación de todos los ciudadanos y que ésta se inicie en las escuelas y en los institutos, siendo dianas de la formación para convertirse en futuros instructores los maestros y los enfermeros. Parece demostrado que el modelo de cursos cortos

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con videoinstrucción y utilización de maniqués es de gran utilidad para la difusión de las técnicas de resucitación. Parece conveniente la liberalización de la utilización de los desfibriladores externos automáticos (DEA) y la reducción de las exigencias formativas en soporte vital básico y DEA para aquellos profesionales no sanitarios que puedan utilizarlos. La formación a nivel sanitario debe mejorarse en las escuelas de medicina y enfermería a nivel de pregrado. Los profesionales sanitarios deberán recibir una formación acorde a sus necesidades y deberá destacarse el desarrollo de habilidades no técnicas, como el liderazgo y el trabajo en equipo. El modelo formativo con la utilización de instructores y maniqués de baja fidelidad sigue siendo un elemento básico y fundamental en la formación. La formación mediante la evaluación del desempeño es una técnica que debe implantarse en todas aquellas áreas donde se presenten casos de parada cardíaca y el equipo de profesionales sanitarios haya intervenido. La simulación parece orientarse como la técnica actual y futura para la formación en distintos ámbitos sanitarios y, cómo no, dentro de este importante campo como es el de la resucitación. Finalmente, la investigación en formación en resucitación debe ser considerada como un claro ejemplo de ciencia translacional, en la que estudios rigurosos de adquisición de habilidades con medida de resultados, trasladen las mismas al entorno clínico, para el análisis de su repercusión sobre la atención de los pacientes.

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Introduction

Cardiac arrest (CA) remains one of the leading causes of death, and as such represents an important health problem. In the industrialized world, CA affects between 30 and 55 out of every 100,000 individuals a year, with a survival rate that does not reach 8% in the best of cases.¹ Attempts to improve the response to such situations implicate a broad range of people, including general citizens, police and security personnel or non-sanitary emergency system members, relatives of the affected patient, and healthcare professionals of different kinds and levels. Survival in sudden CA is determined by the quality of the scientific evidence supporting the international guides or recommendations, the effectiveness of training, and the resources used to implement the mentioned guides. This is what is known as the survival formula.²

Since its birth a little over 50 years ago, the science of resuscitation has been closely linked to teaching and training in those techniques scientifically found to be useful in treating CA. Cardiac massage and mouth-to-mouth ventilation were described in the early 1960s, and at that same time the first mannequin was presented for practicing these techniques and for facilitating the work of the trainers. Since then, training in resuscitation techniques has grown continuously, and at present there are thousands of people who attend training courses in these procedures each year. Likewise, innumerable scientific studies have been and continue to be published in the field of resuscitation training,³ attempting to evaluate the effectiveness of the different techniques, with a view to transferring them to the clinical setting and assessing their effects in terms of patient recovery.

Publication was made in 2010 of the latest resuscitation guides of the ILCOR (International Liaison Committee on Resuscitation). Given the importance of the topic, this organization created a specific training work group in charge

of reviewing the scientific evidence in the field, and whose conclusions are reflected in the definitive publication on the part of both the European Resuscitation Council (ERC) and the American Heart Association (AHA) of a chapter presenting the basic principles of training in resuscitation.^{4,5}

Bases of training in resuscitation

From its start, training in resuscitation has been based on the gaining of knowledge related to cardiac arrest, and fundamentally on the acquisition of psychomotor skills allowing the students to act effectively in the case of having to operate as resuscitators in a genuine scenario of cardiac arrest.

Training structure

At present, teaching in resuscitation is fundamented on the concepts of the universal teaching structure and its three steps (*Set*, *Dialogue*, *Closure*):

1. Preparation of the training setting and its concepts (*Set*).
2. Development of the actual training process, with its corresponding methods (presentation, demonstration, interrogation, etc.), also known as the *Dialogue* step.
3. Conclusion or *Closure* of the process.

A key element in the teaching of resuscitation is the acquisition of technical skills, which on the basis of the aforementioned teaching structure would be set within the development or *Dialogue* step, with the known four-phase approach:

1. Demonstration of the technique by the instructor at normal speed.
2. Demonstration by the instructor at slow speed, explaining what is being done.

3. Demonstration guided by the student, explaining what is being done.
4. Demonstration of the technique by the student at normal speed.

The acquisition of skills is fundamented upon the motor memory of the individual, and is based on two main aspects: observation and interiorization of the verbal message, and performance of the exercise. In reference to the above four phases, fundamental importance would correspond to phases 2 and 4.⁶

Training strategies in resuscitation

Training in resuscitation must center on strategies aiming to increase the percentage of cardiopulmonary resuscitation (CPR) procedures performed by witnesses, and the use of automated external defibrillators (AEDs).⁵

A series of measures should be considered to this effect:

1. Overcoming of the barriers to CPR performed by witnesses. In teaching future resuscitators, emphasis must be placed on the minimum risks for both the resuscitator and the victim posed by applying the intervention.
2. Overcoming the barriers to adequate identification of cardiac arrest. The methods for identifying that a person is in a state of cardiac arrest must be simplified. The absence of response and of normal breathing, or the presence of inadequate breathing or gasping, must be conveyed to the students as representing simple signs of cardiac arrest.
3. Knowledge of the personal limitations as resuscitators. The students must realize that CPR requires vigorous exercise, and must be aware of their own limitations.
4. Overcoming the barriers against use of the AEDs. Lay persons must be made aware that AEDs are safe and effective, and can be used without prior instruction—though due training is also advisable when developing programs for public access to defibrillation.

Evaluation process

Evaluation of the acquired skills is a key element of training, and should serve as the basis for ensuring that the students have adequately assimilated the teachings received—checking their capacity to apply them when necessary. Evaluation strengthens the retention of skills. In contrast, the evaluation of the knowledge based on written multiple-response tests has not been shown to be directly correlated to such acquisition of skills by the students in resuscitation training.⁷

Recycling intervals in resuscitation training

There is controversy regarding the appropriate interval from first training to recycling, and as refers to the most adequate methodology, with a view to preserving competence in the acquired skills. Traditionally, the recommendation has been to ensure recycling at least every two years, though the current tendency focuses on training in resuscitation based

on competences, i.e., simple evaluation of the latter, with reinforcement where necessary.

The best approach for preserving competence in the acquired skills has therefore not been established. The tendency is to conduct evaluation activities and reinforcement of skills in the two years following initial training.⁵

Who should receive training?

The ideal situation would be for all citizens to have knowledge of the resuscitation techniques. On the other hand, there is not enough evidence on the application of training interventions in those populations at high risk of cardiac arrest. However, it seems clear that training of the relatives of a subject at risk can reduce their anxiety and improve their emotional response by making them feel capable of starting resuscitation.⁸

The people who require training in resuscitation range from lay persons in general to non-healthcare professionals who in their work may require such skills (security personnel, civil protection workers), and of course also those healthcare professionals working in a broad range of settings at community level, in medical emergency services, general hospital areas, and fundamentally critical patient care.⁹

The level of teaching and therefore of the acquisition of knowledge and skills must be adapted to the needs of the different types of students, and a training style is required that guarantees the acquisition and retention of such skills. Those professionals who in the context of their usual work may be expected to have to apply resuscitation require important knowledge of the current resuscitation guides, and must be able to use them effectively as part of a multidisciplinary team. These individuals therefore need more complex training comprising both technical and non-technical skills, such as teamwork, leadership, and structured communication.¹⁰

Citizen training

In sudden cardiac arrest it has been shown that the application of resuscitation techniques by the witnesses of the event reduces mortality, and that if such interventions are not carried out immediately, the possibilities of survival decrease by up to 10% for every passing minute of time. Likewise, it has been demonstrated that those citizens who receive training in resuscitation techniques tend to apply the latter more often when witnessing cardiac arrest.¹¹ The extensive experience gained by two communities, one in the region of Kyoto (Japan) and the other in Sweden, with the development of training programs involving a large number of citizens from the general population, has demonstrated progressive improvement in survival in the face of out-hospital cardiac arrest.^{12,13}

An important element in the development of these strategies for community training in resuscitation techniques is the survey-based determination of the knowledge of the general population in relation to resuscitation maneuvering, the way in which an AED works, and what to do in the case of a medical emergency. In our setting, the Spanish Cardiopulmonary Resuscitation Council (CERCP) has conducted a survey among the general population. In this

context, the degree of knowledge referred to sudden cardiac arrest and to resuscitation techniques was found to be clearly improvable.¹⁴

On the other hand, the analysis of the project developed in Sweden, regarding resuscitation training of the population through intermediate instructors in charge of citizen education, revealed that the groups most implicated and which in turn trained a larger number of people corresponded to teachers and nursing personnel.¹²

In Japan, the program for access to defibrillation showed that in addition to the installation of a large number of AEDs, widespread training of the population in resuscitation techniques and defibrillator management, mediated by the fire-fighting professionals of the country, resulted in improved survival of out-hospital cardiac arrest.¹⁵

At what age can training be started?

A number of studies have shown that from 13 years of age and with a body weight of 50 kg, people are physically capacitated to perform resuscitation techniques, and on the other hand have the necessary mental maturity to understand the importance of cardiac arrest.¹⁶ As early as 2003 and 2004, the ILCOR and the American Heart Association (AHA), respectively, recommended the introduction of training in resuscitation in the school curricula, in application to both teachers and students.^{17,18} The recommendation was for training in resuscitation and familiarization with the AED to form part of the secondary education program. The reason for considering schools to be a good place for introducing training in resuscitation techniques is that close to 100% of the population passes through the schooling system. Likewise, the young individuals trained in this way frequently visit public places, where out-hospital CA can occur, and where they can become potential resuscitators. On the other hand, it has been found that prior training in resuscitation techniques increases the changes that witnesses of CA will actually apply the techniques. Indeed, mere awareness of the need to activate the emergency system may be sufficient, since a simple call may serve to start resuscitation techniques guided by telephone.¹⁹

In sum, training in CPR techniques in schools should be an important goal in our setting. In Spain, experience in citizen training and more specifically in school populations is gradually being introduced, and some regions in the country have become familiarized with activities developed by the emergency services or by the Red Cross.

On the other hand, there are no upper age limits for starting training in resuscitation, or limits in the capacity of adults to perform the techniques. It has been shown that individuals between 50 and 75 years of age acquire the corresponding knowledge and skills, and are perfectly able to perform CPR.²⁰

Levels of training

In simple terms, we can distinguish two levels of training: (a) basic training in CPR and the use of an AED, and (b) training in advanced life support.⁴ Providing training in resuscitation techniques for lay persons increases knowledge of how to perform these maneuvers, and as has been commented

Table 1 Contents of training in basic life support and semi-automated defibrillation.

- Protection against any risk before stating CPR
- Identification of cardiac arrest by assessing consciousness, opening the airway and evaluation of breathing
- Identification of gasping as abnormal breathing and a sign of cardiac arrest in unconscious individuals that fail to respond
- Performance of high quality chest compressions
- Use of feedback devices during CPR training
- Inclusion of rescue ventilation in all training in basic life support and semi-automated defibrillation in standard CPR. In certain situations, CPR with only chest compressions may have potential advantages over compression and ventilation

above, CPR performed by witnesses and early defibrillation can save lives in the event of cardiac arrest.

The fundamental elements or contents of training in basic life support and semi-automated defibrillation are summarized in [Table 1](#).

The ideal situation would be for all citizens to receive training in the CPR techniques, both chest compressions and ventilations, in 30:2 proportion or ratio. If training time is limited, emphasis can be centered on the teaching of chest compressions only. Those people with responsibility in their workplaces as first-intervening subjects, security personnel, children caretakers, or others, must know how to perform chest compressions and ventilations. The possible resuscitators of children must be aware of the need for rescue ventilations in order to perform correct resuscitation in victims of this kind. Although all citizens should be encouraged to participate in CPR training, the fact of not having received any such training should not be a barrier against the performance of resuscitation with only chest compressions—preferably guided by the instructions from the emergency service telephone operator.⁴

Advanced training in resuscitation generally corresponds to the resuscitators of healthcare services. The knowledge which these professionals must have should be adapted to the individual needs in each case, in relation to the patients seen and to the concrete role played within the medical care system when responding to cardiac arrest. In the case of advanced life support, it seems clear that regardless of the techniques and knowledge gained, an important part of training for improving patient survival is adequate performance in terms of teamwork and leadership.

The key elements of training in advanced life support are described in [Table 2](#).

In special cases and for personnel with specific dedications, training should cover advanced airway management, the management of peri-arrest arrhythmias, resuscitation in special circumstances, knowledge of the techniques for gaining venous access, the use of drugs, and especially post-resuscitation care in those cases where the victim recovers spontaneous circulation.⁴

Table 2 Contents of training in advanced life support.

- Prevention of cardiac arrest
- Performance of high quality chest compressions
- Performance of defibrillation including equipment charging during chest compressions, in the event manual defibrillation is carried out
- Knowledge of the advanced life support algorithms
- Acquisition of non-technical skills, such as teamwork, leadership, and structured communication

Training methods

While still the main approach used today, classical training based on physical-presence courses and instructors is undergoing an active change. The new audiovisual technologies offer different possibilities, expanding diffusion of the resuscitation techniques, with greater accessibility to knowledge and training. It has been shown that even simple theoretical presentation or the use of multiple-choice tests with no prior course exert positive effects upon the attitude of people in reference to cardiac arrest and CPR.

Training prior to physical-presence courses already forms part of the adequate training process in resuscitation. Training before the course can be based on different methods, such as the use of manuals, the conduction of theoretical tests, and so-called e-learning. Although it appears to be well accepted by the students, pre-course training based on this system, compared with standard manual-based preparation, was not shown to offer an increase in cognitive or psychomotor skills during the cardiac arrest simulation tests. Many studies of alternative teaching methods have reported equivalence or benefits derived from video- or computer-assisted teaching, with a reduction in the time which the instructors must spend with the students.²¹

Training with mannequins and instructors

Teaching in resuscitation with mannequins and instructors has been shown to be very useful for the diffusion of such training. This method offers the advantage of contact with expert instructors and the transmission of their teachings and practices through the use of mannequins for learning the techniques. The inconveniences comprise the lack of thorough evaluation on the part of the instructors in some cases, a lack of adequate realism (dependent upon the simulation equipment used), and the need for continued physical presence. This latter element may be questioned if it is confirmed that the simple support of computerized elements in mannequin-based training is superior to student corrections made by the instructors, as suggested by previous analyses.²²

Self-training with mannequins and videoinstruction

This training system fundamentally has been developed in the Scandinavian countries, based on a brief 24 min video and the use of a small mannequin for performing mouth-to-mouth ventilation and compressions. The results of an initial study,²³ conducted in a school population with the video and

mannequin, showed that the number of people which in turn could be trained with these materials within the family and social circles of the students is considerable. As a result, this methodology can be regarded as important for the diffusion of training in resuscitation techniques. Unfortunately, this study did not show that the increase in number of people trained with this method is correlated to a decrease in mortality among patients with cardiac arrest. In contrast, later studies have confirmed that this technique improves the knowledge and skills of the persons who undergo this type of training.²⁴

While the experience gained with mannequins and videoinstruction in teaching basic life support is adequate, the same cannot be said of videoinstruction applied to the management of AED. The results of one study are discouraging as regards the use of this teaching technique for learning how to use the defibrillators; acceptable results would only be obtained if the training program were to include simulated clinical scenarios.²⁵

Online training or e-training

As has been commented, this teaching method has advantages and inconveniences. It has not been shown to improve performance among the students instructed with this system, or the results obtained in terms of CA recovery or more correct performance of the resuscitation techniques.²⁶ In contrast, it has received good acceptance on the part of the students. It is therefore considered that online training or e-training should be used depending on the population targeted for training. It is a formula that is very well accepted by young people used to working with computers.²⁷ The future development of teaching in resuscitation very likely will be based on self-training systems, without the presence of instructors, and making use of tools of this kind.

Performance review

This is a recent technique, but is proving to be very useful for training in resuscitation. Different systems can be used, such as the simulation of CA codes and simulations; the analysis of performance after the CA episode, based on the elements stored in memory by the AEDs; the viewing of videos taped during CPR in emergency situations; or the use of so-called cognitive aids or checklists during the resuscitation of cardiac arrest, with a view to posterior checking of whether the students adhere to the recommendations of the resuscitation guides or not.^{28,29}

Simulation

Instruction with simulators is an essential part of training in CPR. There is great diversity in how simulation can be carried out and used. Simulation can be regarded as offering high or low fidelity, depending on the equipment used and the possibilities it offers in terms of the application of techniques and the fidelity with which the simulation is able to reproduce real-life signs and symptoms.³⁰

Simulation as a training method for healthcare professionals has been used for many years; indeed, there are

Table 3 Steps in the technical learning process.

- Evaluation of the starting point
- Identification of clear learning objectives, with units ordered by level of difficulty
- Training activities focused on such objectives (practice of skills)
- Definition of minimum standards of competence
- Evaluation system precisely documenting mastery of the technique of each unit
- Gradual progression if performance is adequate or superior
- Continuous and repetitive practice until the minimum standards of competence are reached

Table 4 Goals of training in resuscitation among health-care workers.

1. Development of skills and knowledge suited to the level of responsibility of the subjects involved
2. Obtainment of measurable changes in performance in situations of cardiac arrest
3. Recycling as required, with time intervals related to the probability of having to apply or develop the learned knowledge and skills
4. Provision of training at an accessible level
5. Attractive and friendly training methods
6. Emphasize with the students the need to develop the learned skills

references dating back to the XVIII century on the use of simulators, fundamentally in obstetrics.

Simulation-based training reinforces the acquisition of clinical skills, focusing on the student rather than on the patient, affording safety, a realistic environment, and feedback and analyses of the development of user skills. The learning of a technique fundamentally requires practice, and involves multiple steps (Table 3).³¹

There are no conclusive data demonstrating that greater realism with the use of high-fidelity mannequins implies improvement in CA patient survival when CPR is performed by individuals who have been trained with these tools. Large training centers have been developed, with sophisticated equipment that can simulate practically any critical situation.

Apart from classification as high or low level depending on the capacities of the mannequins employed, simulation can be divided into: (a) scenic simulation, involving scenarios that reproduce different situations and which can even include actors, or robotic simulation only with the use of sophisticated equipment; and (b) virtual reality simulation, a more recent modality which in addition to mannequins of greater or lesser fidelity includes computerized systems with accessories allowing students to work in a virtual reality setting.³²

High-fidelity simulation is useful for assessing the efficacy of the resuscitation teams and even for comparison with the results obtained in real-life CA situations.³³ However, apart from sophisticated equipment, this methodology requires important and careful intervention on the part of the educators, since they must define the concrete skills and the most relevant training strategies, develop appropriate assessment methods, check the validity of the evaluation tests, and consistently evidence the validity of the possible interferences with the assessment methods.²⁹

Training of healthcare personnel

Training in resuscitation is an obligation among healthcare professionals working in direct contact with patients in any occupational setting. Likewise, it is the responsibility of the healthcare center management to ensure the existence of an organized CA response system, with the presence of personnel adequately trained to deal with such situations.

On considering the training in resuscitation received by medical students as future healthcare professionals that must be familiarized with the resuscitation techniques, it is seen that such teachings generally have not been applied as much as would be desirable – though this area is gradually being developed in the Spanish medical schools. It is a fact that training in CPR is limited among medical students at the start of the career, as well as among recently graduated physicians at the start of their specialized residency training.^{34,35} In contrast, training in the form of immediate life support courses during the career improves the competence of these students upon graduating and on starting their residency period.³⁶

The level of training of healthcare professionals depends on their usual working activity. The training received by a physician working in a primary care center cannot be expected to be the same as that received by a physician belonging to the mobile unit of an emergency service or to an Intensive Care Unit.

The training of healthcare professionals working in non-critical hospital areas has been shown to reduce the number of cardiac arrests, by improving knowledge of those situations which can trigger CA, and ensuring prompt intervention of the response teams in charge of caring for patients potentially susceptible to suffering CA. The use of immediate life support courses targeted to most of the healthcare personnel of a London hospital resulted in a decrease in the number of cardiac arrests, as well as an increase in the number of internal emergency team alerts in relation to patients at risk of suffering CA.³⁷ All these show that the training of healthcare personnel is the first link in what is regarded as the in-hospital CA prevention chain.³⁸

As has been commented, training in resuscitation among healthcare professionals must include non-technical aspects such as leadership, communication, optimum teamwork, the updating of management recommendations, the use of clear guidelines, and adequate use and management of the tasks of each individual member on the resuscitation team.

The goals of training in resuscitation among healthcare professionals are summarized in Table 4.³⁹

The best way to train healthcare professionals is to use complete charge simulations, with the development of leadership skills and the use of posterior analytical methods with event reporting.

Non-standardized training sources

The interest in this discipline and in facilitating training and making it accessible has led to the development of supporting elements that can be accessed on the internet or via the applications in new-generation mobile phones, together with the generation of strategies designed to make learning easier and more attractive—including the use of games or music for retaining certain skills, such as the required frequency of chest compressions.^{40–44}

Training and authorization for the use of an automated external defibrillator

The use in Spain of AEDs by non-sanitary personnel is defined by different Autonomous Community regulations. These regulations establish the conditions for installation and for authorization of the use of such equipment, with the requirement of different training courses, each with a duration of between 8 and 12 h, and of recycling courses at certain intervals.

These legal regulations constitute barriers to the diffusion of the installation of AEDs, and in turn have generated a sector pursuing economical benefits, dedicated to the training of the potential users of these devices.

Recently, the Basque Country has published an amendment to the previous Autonomous Community regulation tending to normalize the situation and reduce the barriers facing the installation of these systems, obviating the prior requirement of exhaustive training on the part of the people who are to use the defibrillators. This new tendency is probably fundamented upon the medical literature, which shows that AED training courses lasting between 2 and 4 h are sufficient for acquiring the necessary handling skills.⁴⁵

Training programs

The Spanish Society of Intensive and Critical Care Medicine and Coronary Units (*Sociedad Española de Medicina Intensiva, Crítica y Unidades Coronarias*, SEMICYUC), through its National Cardiopulmonary Resuscitation Plan, has developed a comprehensive training program with courses accredited by the continued training commission of the Spanish National Healthcare System for healthcare professionals, as well as for other non-healthcare professionals and citizens in general.

The SEMICYUC, integrated within the CERCP, follows the recommendations of the ERC in relation to its courses and training cycles, and orientates its educational activities towards those of this European supranational institution.

On the other hand, the ERC develops a range of training material, adjusted to a large catalog of courses, which in general lines are analogous to those of the SEMICYUC (Table 5).

Summary of the ERC 2010 recommendations on training

In its latest recommendations on resuscitation, the ERC presented its conclusions on training in this field. The key

Table 5 Catalog of courses of the European Resuscitation Council.

- Course in basic life support and automated external defibrillation
- Instructor course in basic life support and automated external defibrillation
- Course in immediate life support
- Course in advanced life support
- European course in pediatric life support
- European course in pediatric immediate life support
- Course in neonatal life support
- Generic instructor course

education issues, identified by the Training, Implementation and Equipment working group of the ILCOR during evaluation of the evidence of the 2010 Guides, were the following⁴:

- The training interventions must be evaluated to ensure that they reliably achieve the established learning objectives. The aim is to guarantee that the students acquire and retain the skills and knowledge that will allow them to act correctly in the face of true-life CA, and to improve the prognosis of the patients.
- Short self-instruction course with videos/computers and with little or no instructor support, combined with practical manual exercises, can be regarded as an effective alternative to life support courses (CPR and AED) guided by an instructor.
- Ideally, all citizens should be trained in CPR with skills including compressions and ventilations. However, there are circumstances in which training in CPR with compressions only is appropriate (e.g., training opportunities with very limited available time). The people trained in CPR with compressions only should be encouraged to further learn CPR with compressions and ventilations.
- The knowledge and skills gained in basic and advanced life support deteriorate in as little as 3–6 months. The use of frequent evaluations will allow identification of those individuals requiring refresher training to help maintain their knowledge and skills.
- The use of CPR devices with alarms or interactive options improves the acquisition and retention of skills, and should be considered for the training in CPR of lay persons and healthcare professionals.
- Increased emphasis on non-technical skills such as leadership, teamwork, task management and structured communication will help the performance of CPR and patient care.
- In order to improve the resuscitation team and also individual performance, team meetings should be held to plan resuscitation efforts, together with meetings to analyze the results obtained in simulated or real-life resuscitation interventions.
- Investigation of the impact of training in resuscitation upon the prognosis of real-life patients is limited. Although studies with mannequins are useful, investigators should be encouraged to study and report the impact of training interventions upon the prognosis of real-life patients.

Conflicts of interest

The authors declare no conflicts of interest.

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