



Simulation and education

A paediatric cardiopulmonary resuscitation training project in Honduras[☆]

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ABSTRACT

Objectives: It is possible that the exportation of North American and European models has hindered the creation of a structured cardiopulmonary resuscitation (CPR) training programme in developing countries. The objective of this paper is to describe the design and present the results of a European paediatric and neonatal CPR training programme adapted to Honduras.

Materials and methods: A paediatric CPR training project was set up in Honduras with the instructional and scientific support of the Spanish Group for Paediatric and Neonatal CPR. The programme was divided into four phases: CPR training and preparation of instructors; training for instructors; supervised teaching; and independent teaching.

Results: During the first phase, 24 Honduran doctors from paediatric intensive care, paediatric emergency and anaesthesiology departments attended the paediatric CPR course and 16 of them the course for preparation as instructors. The Honduran Paediatric and Neonatal CPR Group was formed. In the second phase, workshops were given by Honduran instructors and four of them attended a CPR course in Spain as trainee instructors. In the third phase, a CPR course was given in Honduras by the Honduran instructors, supervised by the Spanish team. In the final phase of independent teaching, eight courses were given, providing 177 students with training in CPR.

Conclusions: The training of independent paediatric CPR groups with the collaboration and scientific assessment of an expert group could be a suitable model on which to base paediatric CPR training in Latin American developing countries.

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1. Introduction

In recent years, under the coordination of the International Liaison Committee on Resuscitation (ILCOR), there has been a major international campaign to agree on guidelines for cardiopulmonary resuscitation (CPR) and the prevention and improved treatment of cardiopulmonary arrest.¹

The prognosis in cardiopulmonary arrest worsens when resuscitation is performed late and/or incorrectly.^{2,3} The training of both health professionals and the general public in CPR is an essential measure for improving the prognosis in cardiopulmonary arrest.^{4,5} One of the most effective means of providing quality CPR training is to offer courses that provide practice as well as theory to small groups of students who perform manoeuvres on mannequins to

simulate real cases.^{6–8} The earliest paediatric CPR courses were started in the United States in 1985.⁹ These were followed by courses in the United Kingdom in 1992¹⁰ and Spain in 1994,¹¹ with a gradual spread to other countries, particularly the more developed countries.¹² The European Resuscitation Council (ERC) has proposed taking the programme to countries with fewer health resources, recommending that the training process be performed on a non-profit basis, facilitating organizational expertise and taking a participatory and advisory role.¹⁰ Similar experiences have been performed in several countries.^{13–15} However, the extension of training to less-developed countries with the purpose of exporting the ERC and American Heart Association (AHA) models has been minimal. The strict imposition of the model and the high economic costs are two of the most important factors that might explain this failure.

The objective of this paper is to describe the undertaking and results of a paediatric and neonatal CPR training programme in Honduras, carried out in collaboration with the Spanish Paediatric and Neonatal CPR group with the aim of supporting long-term self-sufficiency and independence; this programme could serve as a model for extending CPR to developing countries.

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2. Materials and methods

A project was developed to create a paediatric and neonatal CPR training group in Honduras with the scientific collaboration of the Spanish Paediatric and Neonatal Resuscitation Group (GERPN) and the Autonomía University of Honduras. This project was funded by the Spanish and Latin American Inter-University Cooperation and Research Programme of the Spanish Agency for International Cooperation and Development (AECID). This financial support provided the teaching material necessary to launch the program.

2.1. Project phases

The project comprised four phases. In the initial phase, the objective was to train a group in advanced paediatric and neonatal CPR, and then as instructors of paediatric and neonatal CPR, and finally to create the Honduran Paediatric and Neonatal CPR Group (GHRCPN). Epidemiology and resources involved in CPR in Honduras are not the same as in Europe. The design of these two courses was adapted to the Honduran reality from the European model, by the Spanish and Honduran project coordinators. Key Honduran personnel selected as students were encouraged to read the CPR textbook before the training. Mannequins and complementary teaching material were bought in Spain and sent to Honduras. Qualified CPR Spanish instructors travelled to Honduras to teach the courses. The GHRCPN was created as a steering group, in charge of the teaching material, and courses scheduling. During the second phase, Honduran instructors gained self-confidence and teaching skills by giving CPR workshops to residents and medical students. CPR workshops were designed to teach in a short period of time (6–8 h) some of the theoretical and practical stations, but not the whole advanced CPR course (e.g. instrumental airway management and oxygen bag and mask ventilation during paediatric CPR). Four Honduran instructors participated as trainee instructors in a CPR course given in Spain by the Spanish group. In the third phase, the Honduran instructors gave an advanced paediatric and neonatal CPR course in Honduras supervised by the Spanish group. In the final phase, the GHRCPN programmed, delivered, and certified CPR courses independently; the Spanish group provided scientific support but no specific accreditation.

2.2. Courses design

The advanced CPR course was an on-site course combining theory and practice and using a teaching approach based on advanced interactive simulation with mannequins.¹⁷ The duration of the course was 30 h, with nine theoretical classes given in a common lecture hall, and eight practical classes given simultaneously in four different rooms, with one lecturer for each group of six students. Different hands-on practice scenarios with case simulation were used in most of the practical classes (basic CPR, instrumental airway management, arrhythmias, initial management of trauma patients, neonatal CPR and integrated advanced resuscitation). When case management finished, self-evaluation and an evaluation among students and instructor were performed. The course syllabus is presented in Table 1. There were minimum differences respect established courses skill stations.^{16,17} Intraosseus access and laryngeal mask positioning were taught despite they are available in few healthcare centres. Case ethiology, environmental factors and number of rescuers were taken into account when designing simulation. Central (femoral) venous catheterization and cricothyroidotomy are additional techniques usually taught in Spain. These were eliminated from the programme because there were no specific mannequins available in the Honduras course. Nevertheless, learning these skills is not the aim of a standard advanced CPR course, and they are not included in most of the European or North Amer-

Table 1
Advanced Life Support Program Course.

I. Theoretical classes
1. Cardiopulmonary arrest. Concepts and prevention in children.
2. Paediatric basic life support.
3. Instrumental airway management and ventilation.
4. Vascular access, drugs and fluids.
5. Monitoring, diagnose and treatment of arrhythmias.
6. Neonatal resuscitation.
7. Post-resuscitation stabilization; initial management and stabilization of paediatric trauma patients: ethics.
8. Integrated paediatric advanced resuscitation.
II. Practice classes
1. Basic life support (infant manikin): non-instrumental airway management, mouth-to-mouth ventilation, chest compressions and coordination. Manoeuvres to relief Foreign-body airway obstruction. Hands-on practice and case simulation.
2. Basic life support (older child manikin). Non-instrumental airway management, mouth-to-mouth ventilation, chest compressions and coordination. Manoeuvres to relief Foreign-body airway obstruction. Hands-on practice and case simulation
3. Instrumental airway management and ventilation: Guedel Cannula positioning, suction, bag and mask ventilation, endotracheal intubation, laryngeal mask positioning. Hands-on practice and case simulation.
4. Vascular access, drugs and fluids. Intravenous and intraosseus needle insertion in plastic arm, leg and chicken's bone. Drug doses calculation, preparation and administration. Intratracheal tube drug administration. Hands-on practice.
5. Monitoring, diagnose and treatment of arrhythmias. Interpretation of EKG, diagnosis of arrhythmias and defibrillation technique. Hands-on practice and case simulation.
6. Initial management and stabilization of paediatric trauma patients. Helmet withdrawal, collar and spinal table positioning. Hands-on practice and case simulation.
7. Neonatal resuscitation. Umbilical intravenous access. Leadership and team coordination. Hands-on practice and case simulation.
8. Integrated advanced resuscitation. Leadership and team coordination. Hands-on practice. Case simulation.

ican courses. The advanced CPR course for instructors also covered theory and practice, and was designed to train instructors; the participants were doctors who had previously been certified in paediatric and neonatal CPR. The teaching approach involved advanced interactive simulation with theory classes complemented by practical ones using mannequins. Using the same methodology as in the CPR course, instructor students were asked to design scenarios and run simulation cases. Both self-evaluation and instructor evaluation and feedback were incorporated, based on the model of courses undertaken in Spain.^{16,17} The course was 22 h long, with six theory classes given in a single lecture hall, and seven practical classes given simultaneously in three different rooms, with the participation of one lecturer for each group of five students. The course syllabus is shown in Table 2. The material used for the practical classes in both courses is described in Table 3.

Table 2
Advanced Life Support Instructors Program Course.

I. Theoretical classes
1. Types and organization of paediatric life support courses.
2. Teaching techniques and educational methods.
3. Mock codes preparation.
4. Evaluation methodology.
5. Practice demonstration.
II. Practice classes
6. Basic life support.
7. Instrumental airway management and ventilation.
8. Vascular access, drugs and fluids.
9. Techniques of oral expression: public speaking.
10. Monitoring, diagnose and treatment of arrhythmias.
11. Neonatal resuscitation.
12. Integrated advanced resuscitation.

Table 3
Material used in practical classes.

1. Infant manikin for basic life support (Resuscibaby®, Laerdal).
2. Older child manikin for basic life support (Resuscijunior®, Laerdal).
3. Infant child intubation head (Laerdal).
4. Paediatric arms for vascular access (Laerdal).
5. Paediatric legs for intraosseous access (Laerdal).
6. Paediatric arrhythmias simulator (Laerdal).
7. Neonatal manikin for resuscitation.
8. Infant Advanced Life Support manikin (ALS Baby®, Laerdal) for infant advanced life support (Laerdal).
9. Older child advanced life support manikin (Megacode Junior®, Laerdal).
10. Defibrillator.
11. Complementary material (i.e. tracheal tubes, intravenous cannulas, resuscitation bags, laryngeal mask, cervical collars, etc.).

Table 4
Student's evaluations after Advanced CPR Course.

Scale	Post-training
Written evaluation pretraining ^a	6.48
Written evaluation post-training ^a	8.86
Practical infant basic CPR performance ^b	3.47
Practical child basic CPR performance ^b	3.75
Practical infant advanced CPR performance ^b	3.45
Practical child advanced CPR performance ^b	3.52
Self-efficacy basic CPR (%) ^c	100%
Self-efficacy advanced CPR (%) ^c	95%

CPR: cardiopulmonary resuscitation.

^a Rating range from 0 to 10.

^b Rating range from 1 to 5.

^c Percentage of students that considers him/herself able to perform CPR.

All practical classes included interactive case simulation scenarios where CPR was performed in a real time fashion, minimizing interruptions. Skill stations to learn the techniques in instrumental airway management, vascular access, arrhythmias and initial trauma management practical classes were also included.

The Spanish CPR group and instructors did not receive fees. In addition, the GERCPN did not charge for certifying the quality of the course.

3. Results

Initially, an advanced paediatric CPR course was given to a group of 24 Honduran doctors from paediatric intensive care, paediatric emergency, and paediatric anaesthesiology departments. Twenty-three students (95.8%) achieved evaluations on theory and practice sufficient to obtain the Paediatric and Neonatal Cardiopulmonary Resuscitation diploma. One student did not complete the course. The paediatric CPR instructors' course was then given to train 16 of the students who had attended the CPR course, and all passed both the theory and practice components to obtain the diploma of instructor in paediatric and neonatal CPR. Participants in the instructor course were selected according to the qualification in the initial course, professional background and personal engagement. The two courses were given in Honduras by four paediatric intensive care doctors from the GERCPN. The independent Honduran association, the GHRCNP, created as a non-profit scientific group with the scientific collaboration and assessment of the GERCPN, was formed with 15 instructors from a variety of disciplines. Students' evaluations are shown in Tables 4 and 5.

During the second phase of the project, the Honduran instructors gave five CPR workshops as a part of their further training as instructors. Four instructors travelled to Spain, where they acted as instructors in training in an advanced paediatric and neonatal CPR course given by GERCPN instructors.

Table 5
Student's evaluations after Advanced CPR Instructor Course.

Scale	Mean (SD)
Written evaluation ^a	8.5 (1.0)
Practical class performance	
Overall	3.6 (0.3)
Basic CPR	3.5 (0.6)
Airway management	3.4 (0.7)
Vascular access	4.2 (0.6)
Arrhythmias	3.1 (0.8)
Methodology of oral expression	3.8 (0.7)
Neonatal CPR	3.6 (0.7)
Integrated advanced CPR	3.3 (0.7)

CPR: cardiopulmonary resuscitation.

^a Rating range from 0 to 10 (rather than 1–5).

In the third phase, an advanced paediatric and neonatal CPR course was given in Honduras by Honduran instructors, supervised by three members of GERCPN.

In the final phase of the project, the GHRCNP gave four seminar-workshops of 6 h duration, four advanced paediatric and neonatal CPR courses of 30 h duration (certifying a total of 77 doctors), and four basic CPR courses (certifying a total of 100 students).

4. Discussion

Cardiopulmonary arrest is a major health event with a high mortality. A large percentage of survivors suffer significant neurological sequelae.

The millennium objectives of the United Nations for 2015 include a reduction in infant mortality and the creation of a world alliance for development.¹⁸ The major causes of cardiopulmonary arrest in children vary by country (level of socio-economic development), age, and previous state of health (serious disease, malnutrition). Cardiopulmonary arrest in children is therefore a condition associated with high mortality that most commonly affects the poorest populations.¹⁹

In Honduras, 42% of the population is under 15 years of age (paediatric age range). The general mortality rate is 5.36‰ and infant mortality rate is 24.6 per thousand live births.²⁰ The level of socio-economic development, discrimination in policies affecting children's health, and a child's previous state of health (serious diseases, malnutrition) affect the incidence of cardiopulmonary arrest in children and contribute to the high morbidity and mortality in this population in Latin America. Studies in developed countries have shown that specific training in prevention, basic CPR training for the general population, advanced CPR training for out-of-hospital emergency service staff, and reducing the delays in reaching a child in cardiopulmonary arrest are all measures that lead to a significant reduction in mortality.^{2–5} There have been reported some emergency management educational programmes in Pediatric and or Neonatal Advanced Life Support in Vietnam, Zambia and Pakistan.^{13–15} However, exportation of North American and European models has discouraged developing countries from setting up their own structured CPR training. The royalties for AHA and ERC accreditation, teaching materials, and copyright represent a huge cost for many countries. In addition, these associations impose the use of their own texts and teaching methods. Access to uniform, high-quality training in developing countries is very limited, and only a small, elite group of health professionals can pay for such courses, sometimes travelling to another country, as the cost of franchises for teaching centres is high.

Our study is the first report of setting up a paediatric and neonatal CPR training group in a developing country using a model involving the scientific collaboration of European groups with greater experience in CPR training.^{11,16,17} This experience may

serve as a model for the creation of training groups in other countries.

On the instructional side, we consider it highly appropriate to give the initial courses in the country in which the group is to be created. Honduran staff's opinions were highly taken into account when designing the courses and reviewing the contents, especially when referring to epidemiology, risk factors, and resources. No major modifications were needed to adapt the practical classes. The instructors who travel there offer a model to follow, create a style, pass on their enthusiasm, learn the reality of the situation in which the new group is going to function, and can resolve many of the doubts and technical considerations that arise when giving a course that is primarily practical. It is essential to create a group of instructors, selected from CPR course students, who are able to maintain the training chain in order for them to reproduce and extend the courses rapidly and independently. In order to maintain a sufficient quality of training, it is important for the initiator group to follow up and supervise training activities. For this reason, the first courses given by the Honduran GHRCPN were supervised by members of Spanish GERCPN. In later phases, the involvement of the GERCPN will be limited to provide scientific and instructional advice.

Video recorded advanced simulation was not used. These methods could be useful but expensive and complex. They need sophisticated material and take a long time. In our opinion they are not appropriated to teach and extend CPR courses in developing countries.

On the organizational side, it is important to create critical mass at the centre, to maintain the momentum (the GHRCPN in this case) and to organise and develop the training plan inside the country. In our opinion, this group should have sufficient freedom to modify and adapt the syllabus and instructional approach of the courses to the characteristics of their own environment. Each country knows what it needs and the best way to carry out an educational project. The collaboration between groups can be stable, but must aim at economic, scientific, and educational independence.

The economic aspect of the plan depends on initial funding to launch the project, as the costs of the training materials, particularly the mannequins, are high. Recently, the Spanish–Latin American Network for the Study of Cardiopulmonary Arrest in Childhood (RIBECP) was set up and one of its main objectives is to stimulate and support the creation of paediatric CPR training groups in Latin American countries.²¹ This could be one means of supporting the early stages of development of training in Latin America.

Several barriers and opportunities have been found during the project's development, although inherent learning limitations are the same in every country. In one hand, medical education extension is more difficult in limited basic education countries, despite there were no language barriers. Minor institutional support and a poorly developed Healthcare National System may also contribute. Teaching material limitations sometimes limited skills learning. On the other hand, students showed special enthusiasm and great interest in learning, and instructors felt an extra motivation. All Honduran instructors realized that was very important to acquire enough versatility to teach all the classes.

Our experience in Honduras would indicate that a preliminary economic donation can make the initial development of a training programme possible. Eliminating the payment of royalties for accreditation by the scientific associations of the developed world allows countries with fewer economic resources to develop and maintain their own training programmes. Studies comparing costs of AHA or ERC courses versus non-profit low cost courses could help to analyse the limitations to emergency training programmes implementation in developing countries. In our opinion, the scientific societies at the head of ILCOR should recognize their social obligation to extend CPR training to developing countries by

eliminating the royalties for scientific authorship of their training materials. Prevention and training in CPR must be included in the United Nations aid programmes for development.²² However, fees should be offered to instructors working for the developing country's training group, as the cost would be low cost in this non-profit context and this would favour the self-sufficiency and sustainability of the programme. It is important to draw attention to the fact that the aim of the project is not only to give CPR courses but also to establish a progressive, long-term training programme managed by a local group able to develop paediatric CPR training in its own country, and to contribute to the spread of similar programmes to neighbouring countries.

The short-term objective of the Hondurans CPR group is to certify 100 doctors and nurses per year in advanced paediatric CPR and train 50 basic CPR instructors who will undertake training of the general population. The long-term objectives are to promote international paediatric and neonatal CPR recommendations¹ in Honduras and to provide these courses for health staff, paramedics and the general population; to include CPR training in undergraduate training in medicine and surgery and in nursing, and advanced CPR in the specializations of paediatrics, paediatric intensive care and anaesthesiology; to standardise the courses to be given with regard to syllabus, instructional materials, and accreditation; and to develop guidelines to maintain quality of care, training, and research in CPR.

In conclusion, we consider that the training of independent CPR training groups through scientific collaboration and assessment by countries with experience could be an effective model for developing paediatric CPR in Latin American developing countries.

Conflict of interest statement

All authors disclose any financial and personal relationships with other people or organizations that could inappropriately influence their work.

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