

Strengthening the Chain of Survival: Cardiopulmonary Resuscitation Workshop for Caregivers of Children at Risk

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Abstract

Background: Parents and caregivers should receive training regarding pediatric cardiopulmonary resuscitation (CPR) because this knowledge improves survival. We conducted a study as part of a Patient Safety Project to improve caregivers' CPR knowledge and skills. We also aimed to improve the quality of patient care. **Methods:** We performed a prospective, longitudinal study in 2013–2014 in a pediatric hospital. We enrolled the caregivers of all patients admitted with a diagnosis of an acute life-threatening event, apnea, or choking. We provided a 45-minute CPR workshop for parents at discharge and evaluated the results using a test before, immediately after, and at 1 and 3 months after the workshop. Participants also completed an evaluation survey about the CPR workshop. **Results:** We admitted 62 patients [median age, 1 mo (0.5–2 mo)]. We provided 62 pediatric CPR workshops to 106 enrolled relatives. The median score was 5 (CI, 3–6) out of 10 at baseline, which increased to 8 (CI, 7–10) immediately after the workshop ($P < 0.01$). After 1 and 3 months, the median score was 8 (CI, 6–9; $P < 0.01$). The severity of the acute life-threatening event episode correlated with a better score ($P = 0.02$). The utility of the workshop scored 9.9 out of 10. **Conclusions:** This CPR workshop significantly increased CPR knowledge and confidence, and this was maintained up to 3 months post-training. Caregiver satisfaction was high. (*Pediatr Qual Saf* 2019;4:e141; doi: 10.1097/pq9.000000000000141; Published online February 7, 2019.)

INTRODUCTION

Pediatric hospital medicine is a field that seeks to provide diagnosis and cure for their patients, but also education and prevention of common pediatric problems. The Hospital Infantil Gregorio Marañón (Children's Hospital Gregorio Marañón) is a public, tertiary care hospital in Madrid, Spain. It has 185 beds and 8,000 admissions per year. It is a referral hospital in the area and cares for a population of 135,000 children 16 years old and younger.

The Hospital Pediatrics Service at The Hospital Infantil Gregorio Marañón plays an important role in the care

of admitted patients with 1,800 patients admitted to the service per year, 1,000 outpatient visits, and numerous consults from other specialties. At our center, the Hospital Pediatrics Service is responsible for developing quality improvement programs, implementing a culture of patient safety, and being a leader in health education for our patients.

Since 2012, our service has participated in a hospital-wide multidisciplinary project to improve patient safety. One of the goals of the project is to transition to a “family-centered” patient care model. Family participation in the care process



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Preliminary data were presented at 2 national meetings of the Spanish Pediatric Association (Asociación Española de Pediatría), first as an oral presentation, June 2013, Sevilla, Spain, and then as a poster presentation, June 2015, Bilbao, Spain. The poster was selected as one of the best abstracts presented.

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This project also received the VI award for “Best Quality Improvement Practices in Healthcare Service of Madrid” (Mejores Prácticas en Gestión de Calidad en el Servicio Madrileño de Salud) on November 22, 2017.

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is a key component to improve patient safety during and after hospitalization. For this reason, the Hospital Pediatrics Service plays an important role as an educator in health-related topics such as secondhand smoke exposure, the vaccine schedule, and pediatric cardiopulmonary resuscitation (CPR).

In the first year of life, acute life-threatening events (ALTEs), which can precede cardiopulmonary arrest, represent an important cause of critical out-of-hospital episodes. The incidence of ALTE is about 0.05%–6% among healthy newborns.¹

Independent of the cause of ALTE, or now brief resolved unexplained event, parents and caregivers of infants should receive information about pediatric CPR.² Research indicates that immediate and effective bystander CPR for victims of cardiac arrest improves survival, and knowledge of CPR guidelines increases the rate of bystander CPR.^{3–5}

The “Pediatric Advanced Life Support” course provided by The American Academy of Pediatrics teaches the concept of the “chain of survival.”⁵ The chain of survival emphasizes the role that adult knowledge of infant CPR (outside of healthcare personnel) plays in the prevention and treatment of the causes of ALTE/brief resolved unexplained events, especially in those adults who take care of pediatric patients.

Our service had previously been teaching CPR to the caregivers of our patients admitted due to a life-threatening event (about 70 patients per year), with the aim of improving survival in these children if a second event occurred. However, this training was not standardized. For this reason, in 2013, we conducted a prospective study to improve caregiver CPR knowledge and skills, thus strengthening the “chain of survival” between patients and the healthcare system.

METHODS

We designed a prospective, longitudinal study with an educational intervention, and conducted it from 2013 to 2014 in a tertiary care pediatric hospital in Madrid, Spain. The Ethical Committee of our institution (Comité Ético de Investigación Clínica Hospital General Universitario Gregorio Marañón; address: C/Dr. Esquerdo, 46, 28007, Madrid, Spain) approved our project (CEIC 332/13) on December 18, 2013. At the time of development of this project, the term ALTE was standard. We enrolled all admitted patients with a diagnosis of ALTE, apnea episodes, and choking. We used the following inclusion and exclusion criteria:

Inclusion Criteria

- Caregivers responsible for the hospitalized patients (admitted with the above diagnoses) who agreed to participate in the workshop and voluntarily completed the pre- and post-training test and survey. Participants gave verbal informed consent.

Exclusion Criteria

- Workshop participants who did not want to complete the study tests.
- Caregivers who did not speak the language of the workshop (Spanish).
- Caregivers who had previous healthcare-related pediatric CPR training. (These parents received training, but we excluded them from the analysis.)

We collected clinical and epidemiologic data by chart review. We provided the pediatric CPR workshop to all parents or caregivers of patients with the above diagnoses (per protocol), regardless if they were willing to participate in the study.

Before the workshop, participants completed a 30-minute (maximum) test of 10 multiple choice questions about basic pediatric CPR (see **Appendix 1**, Supplemental Digital Content, available at <http://links.lww.com/PQ9/A71>). The authors of the study jointly developed and approved the test. The day before discharge, we gave participants a written information booklet about basic pediatric CPR and foreign body airway obstruction basic life support maneuvers (with the European Resuscitation Council 2010 recommendations⁶) and encouraged them to review it. After this, we gave the pediatric CPR workshop, using an infant manikin. The workshop instructors were pediatric physicians with training in advanced pediatric life support. After the workshop, participants again completed the same 10 questions test. The caregivers completed the same test again 1 and 3 months after discharge. We scheduled subsequent follow-up visits until 12 months postdischarge. Patients were called and received a letter at their home address with the scheduled appointment.

At the 1-month follow-up, we also asked participants to evaluate the workshop. The survey (see **Appendix 2**, Supplemental Digital Content, available at <http://links.lww.com/PQ9/A71>) asked about the caregivers’ level of satisfaction with the workshop, the global utility of the workshop, and if they thought necessary to repeat this workshop, and how often.

We compared the data among baseline knowledge, immediate postworkshop knowledge, and at 1 and 3 months follow-up. We expressed numeric variable results by median and interquartile ranges (IQRs) or means and SD where appropriate and the categorical variables in percentages. We performed a statistical analysis of before–after paired data with χ^2 , Mann–Whitney, Kruskal–Wallis, and Friedman tests. We performed multivariable linear regression with the dependent variable the number of correct answers immediately after participating in the workshop, and independent variables were the severity of episode (defined as that which required admission to the pediatric intensive care unit), underlying condition, and the caregiver’s level of education attained. A *P* value of < 0.05 was considered statistically significant.

RESULTS

We prospectively enrolled the eligible caregivers of 62 patients admitted to our service with any of the previously described diagnoses. Table 1 shows the patient characteristics.

Their median age was 1 month (IQR, 0.5–2). We conducted 62 pediatric CPR workshops to 106 relatives (mothers, fathers, grandparents, and other). The median age of mothers was 33 years (IQR, 29–36), the median age of fathers was 33 years (IQR, 28–36), and the median age of grandparents was 50 years (IQR, 46–54). Fifty-eight percent of caregivers were mothers, 36.8% were fathers, and 5.7% were other caregivers.

The median duration of the workshop was 45 minutes (IQR, 40–50). One hundred one caregivers completed the test at baseline, 93 immediately after the workshop, 36 at 1-month follow-up, and 22 at the 3 months follow-up. Patients and caregivers were enrolled regardless of socioeconomic status. We compared the level of education between caregivers who did follow-up and the ones who were lost to follow-up, and there was no significant difference (high school studies: 33.3% versus 32.6%, respectively, $P = 0.99$; college studies: 5.5% versus 8.5%, respectively, $P = 0.70$).

Concerning baseline knowledge about CPR, the median score was 5 points (CI, 3–6) out of 10, which increased to 8 points (CI, 7–10) immediately after participating in the workshop. This difference was statistically significant ($P < 0.01$). After 1 and 3 months, acquired knowledge remained with a median score of 8 (CI, 6–9) and the difference between these results and baseline was again

statistically significant ($P < 0.01$). The difference between the results obtained immediately after the workshop, and the 1- and 3-month follow-up tests were not statistically significant ($P = 0.07$).

In our cohort, a repeat ALTE that required any CPR occurred in 7% of patients, and all caregivers were able to apply their acquired knowledge and skills. Caregivers felt confident in their skills and were very satisfied. All patients recovered well after these episodes.

None of the participants' characteristics (gender, maternal or paternal age, or level of education) correlated with the preworkshop examination scores. However, the multivariate analysis indicated a statistically significant association between the severity of the episode and the presence of an underlying condition with a better result in the immediate postworkshop test [R^2 , 45% [underlying condition ($t = 2.33$ and $P = 0.03$), severity ($t = 2.49$ and $P = 0.02$)]].

We also assessed the participants' evaluation of the course by a survey. The score given to the theoretical and practical part of the course was 9.69 (± 0.62) and 9.65 (± 0.71) out of 10, respectively. Global utility scored 9.87 (± 0.47) out of 10. All participants noted that they were able to practice with the manikin and clarify their questions. Eighty-six percent of the participants wanted to repeat the training frequently, at a mean of 10.4 months (± 6.25 months) after the original training.

DISCUSSION

In our study, we found a significant increase in CPR knowledge of caregivers of pediatric patients admitted because of an ALTE, apnea episode, or choking episode after a 45-minute training workshop. This knowledge remained up to 3 months after discharge. The majority of participants thought the workshop was useful, as demonstrated in the postworkshop survey.

In the United States, the incidence of out-of-hospital cardiac arrest in the pediatric population is reported to vary from 2.6 to 19.7/100,000. Of these, only 27.4% received bystander CPR, and the reported average survival to discharge among this population is only 6.7%.³

In Spain, the "Spanish Study group of cardiopulmonary arrest in children" aims to improve CPR training in healthcare personnel and in laypersons to improve survival. A multicenter prospective study from this group evaluated the characteristics and outcomes of out-of-hospital cardiac arrest in Spanish children. A subanalysis from this study published in 2005 found that initial survival was 47% and 1-year survival was 26.4% and that patients who were initially resuscitated by laypersons or paramedics had higher survival (53% versus 15.2%; $P = 0.001$).^{4,7–9}

Research indicates that CPR courses are effective and they give the families the feeling of situation control and decrease anxiety.^{3,10} Seventy to 80% of cardiac arrests occur at home. These arrests have a lower survival rate

Table 1. Patient Characteristics

Variable	Patients % (Total N = 62)
Median age	
1 mo (IQR, 0.5–2 mo)	
Median gestational age at birth	
39 wk (IQR, 37.5–40 wk)	
Sex	
Female	56.5% (35/62)
Male	43.5% (27/62)
Medical history*	32%
Care provided by EMS before arrival to hospital	3%
PICU admission	8%
Discharge diagnosis	
Obstructive apnea	66% (41/62)
Choking	37% (26/62)
GERD	27% (17/62)
Central apnea	13% (8/62)
ALTE	11% (7/62)
Other†	19% (12/62)
Caffeine prescribed at discharge	11% (7/62)
Cardiac an pulse oximetry monitor device at discharge	14.5% (9/62)
Mortality	0% (0/62)

*Prematurity (4), cardiopathy (patent foramen ovale, ventricular septum defect, pulmonary stenosis, ascending aortic dilatation, aberrant right subclavian artery) (5), transient tachypnea of newborn (5), pyelocalic dilation (1), previous apneas (4), laryngomalacia (1).

†Bronchiolitis (9), choking (17), upper airway abnormality (1).

EMS, emergency medical system, in Madrid called SAMUR, "servicio de atención médica de urgencias"; GERD, gastroesophageal reflux disease; PICU, pediatric intensive care unit.

than a cardiac arrest occurring in a public place. Thus, extensive training is needed to increase the likelihood of CPR being performed before the arrival of Emergency Medical Services personnel. When a layperson initiates CPR before the arrival of Emergency Medical Services, survival increases 2–3 times.¹¹

Parents and caregivers are generally willing to perform CPR, especially on family members. However, their knowledge of current guidelines, both perceived and measured, is poor, and thus, reduces their confidence.³ A study from Saudi Arabia found that public awareness and knowledge on infant CPR were inadequate, even among the younger population and among parents of disabled children. Level of education was unrelated. Fortunately, they were all willing to improve.¹² In our study, we found workshop participants scored a median of 5 out of 10 at baseline, which is suboptimal. In a study by Moran and Stanley¹⁰ from New Zealand, half of the parents reported that they were aware of the adult guidelines, but only 41% were aware of the pediatric CPR guidelines. Additionally, parents felt less confident to perform CPR on children compared with adults. Overall, a lack of knowledge about CPR protocol was evident.

As recommended by American Academy of Pediatrics, pediatricians and pediatric subspecialty providers should lead by example by taking and teaching basic life support training courses and encouraging parents/caregivers to do so as well.⁵ At our hospital, we encourage our staff to advocate for this, and physicians and nurses participated in this project.

Palmieri et al¹ previously described that the majority of CPR course participants believe that it is necessary to repeat training. Any previous CPR training increases confidence in CPR performance. Previous experience increases the knowledge of the correct technique compared with those without previous training.³ Our study population validated this finding as 86% felt the need to repeat CPR training.

In the study by Palmieri et al,¹ authors comment that the course was originally planned only for parents of children who have had ≥ 1 episodes of ALTE. However, they offered CPR training to grandparents, teachers, babysitters, volunteers, and parents of children with cardiac or neurologic impairment.¹ We included all caregivers in our study and received a good response from all family members present at any time during admission.

We did not find a difference between gender and level of education when comparing baseline test scores as some other reports have previously shown,^{10,12,13} but we found a better postworkshop test score in caregivers of children with a severe presentation or underlying health condition.

A previous study on skill retention after CPR training in adults and children found that both groups scored only 50%–55% of the maximum score after 3 months.¹¹ There are very few studies that have evaluated skill or knowledge retention over time. Our study found an improvement in knowledge after training. Participants maintain this knowledge after 1 and 3 months.

The 2015 update on the International Liaison Committee on Resuscitation education guidelines have the following key recommendations: (1) use of high-fidelity manikins is encouraged at training centers and organizations that have the infrastructure, trained personnel, and resources to maintain the program; (2) use of CPR feedback devices can help teach the psychomotor skill of CPR; and (3) 2-year retraining cycles are not optimal, and more frequent training may be beneficial. Studies have shown increased confidence and willingness to perform CPR after repeat training sessions.¹⁴

In our study, we used manikins, and the instructors gave feedback as needed. Even though our manikins were not the high-fidelity devices referred to above, we think our situation may be comparable to other settings in which such technologies are not yet available, and for us, these proved to be useful. We have recently started providing audiovisual materials for caregivers to further reach out to other potential learners who are not able to attend the courses and to give them a chance to review the steps at home whenever they want to. Furthermore, we have implemented in our hospital's intranet system an online pediatric CPR course in the "education for parents" section. This course is available to all parents/caregivers of patients admitted to our service, regardless of the reason for admission.

Our study has some limitations. Our study population was small, and it is a single-center study, so our results may not be generalizable to all populations. We did not test actual CPR skills (only knowledge) at the 1- and 3-month marks due to time and staff limitations. We did corroborate the successful resuscitation skills of those caregivers whose infants had a repeat event. The test content was identical in all 4 time-points to make the score results comparable, but caregivers did not receive feedback for the incorrect answers to questions during any of the 3 testing periods. Families did ask questions and received feedback during and at the end of the workshop (after the first preworkshop test), reviewing all concepts imparted.

Additionally, many of our course participants were lost to follow-up after discharge. However, patients/caregivers were selected regardless of their socioeconomic status, and there was no difference in the level of education between caregivers who followed-up and the ones who did not. Despite this, the patients/caregivers who did follow-up may have been more motivated for unknown reasons.

With the lessons learned, we would suggest future more robust studies with larger number of participants, if able multicenter, and with dedicated staff as instructors and for follow-up visits. We would like to enhance postworkshop evaluations with more complex knowledge and CPR skills tests. It would be ideal as well, if follow-up visits could be done at home or by phone so as to minimize patient loss.

Currently, this quality improvement project is part of our routine family-centered patient care protocols. In

another survey done by patients' families to measure the perceived quality of care, our service scored a median of 8.5 (CI, 8–9.1) out of 10 (unpublished data) after this intervention. This project was the only change in a long time before such survey took place. As reported here, the workshop evaluation survey revealed a high global utility score. There could have been other causes of an increase in perceived quality of care, but we believe this contributed the most.

CONCLUSIONS

Our CPR workshop significantly increased knowledge about CPR in the caregivers of infants admitted for ALTEs, choking episodes, and apneic episodes, and knowledge was maintained up to 3 months after the course. Caregivers' satisfaction and evaluation of the workshop were high, thus improving the perception of the quality of care provided by our unit. Caregivers considered this initiative very helpful, and they felt more confident to perform CPR after training. Families that were required to use their CPR skills after discharge demonstrated that they were capable of doing so. For these reasons, we believe that this work contributes to strengthening the "chain of survival" and could be generalizable to other units and centers.

It is fundamental to combine theory and practice when teaching CPR, allowing participants to use manikins and ask questions. Including families in our patient care model allows us to reach a high level of satisfaction and improve quality of care.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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