

TRAINING AND EDUCATIONAL PAPER

# Advanced Cardiac Life Support Courses: Live actors do not improve training results compared with conventional manikins<sup>☆</sup>

Heberth C. Miotto<sup>a,b,\*</sup>, Braulio R.G.M. Couto<sup>a,c</sup>, Eugenio M.A. Goulart<sup>a</sup>, Carlos Faria Santos Amaral<sup>a</sup>, Maria da Consolacao V. Moreira<sup>a</sup>

<sup>a</sup> School of Medicine, Federal University of Minas Gerais, Belo Horizonte, Brazil

<sup>b</sup> Department of Internal Medicine, Federal University of Minas Gerais, Brazil

<sup>c</sup> University of Belo Horizonte, Brazil

Received 27 April 2007; received in revised form 26 July 2007; accepted 27 July 2007

## KEYWORDS

Advanced Life Support (ALS);  
Basic Life Support (BLS);  
Education;  
Megacode training;  
Resuscitation;  
Manikin;  
Bystander CPR

## Summary

**Primary objective:** To determine whether using live actors to increase the reality of the scenario improves knowledge retention in Advanced Cardiac Life Support (ACLS) Courses.

**Main secondary objectives:** To determine the effects of age, time since graduation from nursing or medicine, sex, medical specialty, and workplace in knowledge retention.

**Methods:** From December 2004 to October 2005, 19 selected ACLS courses were divided at random in two groups: group A (ACLS courses with conventional manikins plus live actors) and group B (ACLS courses with conventional manikins). The live actors vocalized appropriately to create more realistic scenarios. The participants' relevant theoretical knowledge was assessed before the course (pre-test), immediately after the course (post-test), and 6 months after the course (final-test).

**Results:** Four hundred and thirty-five participants were recruited and allocated at random allocated to either group A or B. Overall, the data of 225 participants (51.7%; 111 in group A and 114 in group B) who completed the entire sequence of pre-, post-, and final-tests were analysed. On univariate analysis, the use of live actors, workplace, gender, and healthcare provider profession did not affect pre-, post-, and final-test results ( $p > 0.1$ ). The results in all three tests correlated negatively with time since medical or nursing graduation (95% C.I.  $-0.53$  to  $-0.17$ ,  $-0.43$  to  $-0.2$ , and  $-0.42$  to  $-0.11$ , respectively,  $p < 0.05$ ) and age (and 95% C.I.  $-0.56$  to  $-0.21$ ,  $-0.42$  to  $-0.2$ , and  $-0.38$  to  $-0.07$ , respectively,  $p < 0.05$ ).

<sup>☆</sup> A Spanish translated version of the summary of this article appears as Appendix in the final online version at [10.1016/j.resuscitation.2007.07.031](http://10.1016/j.resuscitation.2007.07.031).

\* Corresponding author at: Rua Paracatú 1555, Apartment 1202, Belo Horizonte, Minas Gerais 30180-91, Brazil. Tel.: +55 31 3335 2447; fax: +55 31 3261 3836.

E-mail addresses: [hcmiotto@terra.com.br](mailto:hcmiotto@terra.com.br) (H.C. Miotto), [bcouto@acad.unibh.br](mailto:bcouto@acad.unibh.br) (B.R.G.M. Couto), [eugenio@terra.com.br](mailto:eugenio@terra.com.br) (E.M.A. Goulart), [cfsamaral@terra.com.br](mailto:cfsamaral@terra.com.br) (C.F.S. Amaral), [moreiram@gold.com.br](mailto:moreiram@gold.com.br) (M.d.C.V. Moreira).

*Conclusion:* The use of live actors did not affect knowledge retention in this group. Older age and a longer period since graduation were associated with the worst scores and the lowest levels of knowledge retention.

© 2007 Elsevier Ireland Ltd. All rights reserved.

## Introduction

The Advanced Cardiac Life Support (ACLS) is a course dealing with the treatment of cardiac emergencies. It was created by the American Heart Association and is used in many countries to train medical and nursing staff to improve sudden cardiac arrest survival.<sup>1</sup> It is a hands-on, practical course that includes the use of manikins and interactive clinical scenarios.<sup>2</sup> Although improvements in skills and knowledge are evident immediately after participants complete the course, the retention of skills (psychomotor capabilities) is poor and declines as early as 2 weeks after taking a cardiopulmonary resuscitation (CPR) course in both healthcare providers and lay persons.<sup>3–7</sup> Knowledge (cognition) retention also declines, but not as fast as skill retention.<sup>8</sup> The same findings have been observed after Paediatric Advanced Life Support (PALS) and Advanced Trauma Life Support courses; thus, though paediatricians and surgeons can learn and improve their knowledge and skills, both knowledge and skills decline quickly if no refresher courses are taken within a short period of time.<sup>9,10</sup>

The mortality and morbidity of cardiac arrest victims are directly affected by the ability of healthcare providers or lay persons to use CPR knowledge and skills appropriately. It is virtually impossible to separate knowledge from skills, since they are interdependent.

During the last few years, many new educational models have been tested in an attempt to improve skill retention; however, no specific teaching method has been successful, except for periodic refresher courses at short intervals.<sup>11</sup> In nursing and medical education, simulation studies have shown that manikin simulation is better than traditional lectures and even better than problem-based learning for the acquisition of critical assessment and management skills.<sup>11,12</sup> Studies using high-performance manikins that allow a greater degree of clinical interaction and permit the participant to attain clinical competence after training improve overall skills and critical assessment.<sup>12</sup> All of these studies assume that the more realistic the scenario, the more the skills improve, and the more knowledge is retained.

The primary purpose of the present study was to determine whether the use of live actors to create realistic scenarios could improve knowledge retention. The secondary purpose was to determine if medical specialty, sex, work at hospital facilities, age, and time since graduation from medicine or nursing affected knowledge retention.

## Methods

From December 2004 to October 2005, 19 ACLS courses were divided at random into two groups: group A (ACLS courses with conventional manikins plus live actors), and group B (ACLS courses with conventional manikins). After obtaining their written informed consent, healthcare providers were

allocated at random to one of these courses without knowing which kind of course would be offered. All courses followed the ACLS instructor manual.<sup>2</sup> The participants' characteristics are summarised by group in Table 1.

Group A: the training scenarios involved live actors who provided vocal feedback and interacted with the healthcare providers to create a more realistic scenario; in some cases, simple manoeuvres, such as checking for open airways and breathing, were permitted. During the ACLS courses, the live actors had critical roles in respiratory arrest, acute coronary syndromes, stable and unstable tachycardia, bradycardia, pulseless electrical activity, ventricular fibrillation, and tachycardia arrest stations. All invasive procedures that are usually taught during ACLS courses were done on conventional manikins (Ambuman®) to prevent harming the actors. In order to avoid any methodological bias, the scenarios and simulations were similar in both groups and followed the cases and scenarios from the ACLS provider manual.<sup>2</sup>

Before and immediately after the courses, participants answered 33 multiple choice questions (pre-test and post-test, respectively) to assess their baseline knowledge and their improvement with training. Six months after the course, the participants completed another test with 33 multiple choice questions (final-test) to evaluate their knowledge retention. All three tests used the same questions, but in a different sequence, and followed the American Heart Association-recommended test used in the regular ACLS course (Fig. 1).

## Ethics

This study was approved by the Ethics Committee of the Federal University of Minas Gerais, Belo Horizonte, Brazil.

## Statistical analysis

Pre-test, post-test, and final-test scores were compared in both groups A and B. Age subgroups, time since graduation from nursing or medicine, sex, medical specialties, and whether the participants were working in hospital facilities were also compared.

The data were analysed initially using descriptive statistics; all data were summarised in tables and graphs. Continuous variables were analysed using Student's *t*-test, ANOVA, and the Kruskal-Wallis non-parametric test. Time since graduation from nursing or medicine and age were evaluated by linear regression.  $p < 0.05$  was used to indicate statistical significance for all variables.

## Results

A total of 435 participants was recruited and allocated at random allocated to either group A or B. Overall, the data of 225 participants (51.7%; 111 in group A and 114 in group B)

**Table 1** Characteristics of participants in the live actor and conventional ACLS courses

		Live actor course (% or $\pm$ S.D.)	Conventional course (% or $\pm$ S.D.)	<i>p</i> -Value
Number		111 (49%)	114 (51%)	–
Age (years)		31 $\pm$ 8	35 $\pm$ 10	<i>p</i> = 0.004
Gender	Male	62 (56%)	68 (60%)	N.S.
	Female	49 (44%)	46 (40%)	
Time since graduation (years)		5.8 $\pm$ 6.9	9.2 $\pm$ 8.9	<i>p</i> = 0.003
Anaesthesiologists		2 (2%)	4 (4%)	N.S.
Cardiologists		14 (13%)	31 (27%)	<i>p</i> = 0.01
General practitioners		69 (62%)	47 (41%)	<i>p</i> = 0.002
Surgeons		8 (7%)	10 (9%)	N.S.
Hospital workers		88 (79%)	88 (77%)	N.S.
Nurses		7 (7%)	10 (9%)	N.S.
Time to final-test (months)		5.5 $\pm$ 1.1	5.4 $\pm$ 1.3	N.S.

$\pm$ S.D. = Standard deviation.

who completed the entire sequence of pre-test, post-test, and final-test were analysed. The remaining 210 participants who only completed the pre-test and post-test were not statistically different from the 225 who completed all three tests (Table 4).

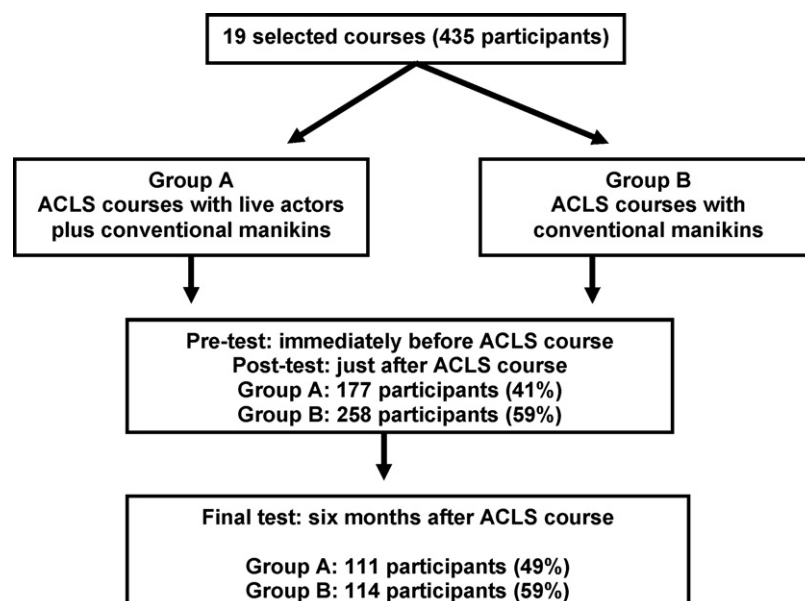
On univariate analysis, the use of live actors, medical specialties, and sex did not affect pre-test, post-test, and final-test results ( $p > 0.1$ ). Healthcare providers who worked at hospital facilities had better pre-test and final-test scores than healthcare providers who worked predominantly in small clinics and offices ( $p = 0.03$  and  $p = 0.002$ , respectively); however, the post-test results were not statistically different (Tables 2 and 3).

There was a negative correlation between a longer interval since graduation from nursing or medicine and all three test scores (95% C.I. pre-test:  $-0.53$  to  $-0.17$ , post-test:  $-0.43$  to  $-0.2$ , and final-test:  $-0.42$  to  $-0.11$ ,  $p < 0.05$ ). There was also a negative correlation between age and test scores (95% C.I. pre-test:  $-0.56$  to  $-0.21$ , post-test:

$-0.42$  to  $-0.2$ , and final-test:  $-0.38$  to  $-0.07$ ,  $p < 0.05$ ). The negative correlation was maintained when the use of live actors was included in the analyses of scores and time since graduation from nursing or medicine (linear regression coefficient 95% C.I. pre-test:  $-0.4$  to  $-0.1$ , post-test:  $-0.45$  to  $-0.21$ , and final-test:  $-0.6$  to  $-0.21$ ,  $p < 0.05$ ) and age (linear regression coefficient 95% C.I. pre-test:  $-0.61$  to  $-0.25$ , post-test:  $-0.44$  to  $-0.21$ , and final-test:  $-0.4$  to  $-0.07$ ,  $p < 0.05$ ) (Fig. 2).

## Discussion

The most important goal of an emergency training programme is to provide the knowledge and skills required to deliver effective patient care, including resuscitation. Patient survival and hospital discharges increase when staff members are trained in ACLS. However, many studies have documented that knowledge and skills deteriorate months,

**Figure 1** Study design.

**Table 2** Pre-, post-, and final-test results

	Mean score of live actor courses $\pm$ S.D. ( $n=111$ )	Mean score of conventional courses $\pm$ S.D. ( $n=114$ )	$p$ -Value
Pre-test	82 $\pm$ 13	84 $\pm$ 9	N.S.
Post-test	91.3 $\pm$ 8	91.6 $\pm$ 6.9	N.S.
Final-test	89.6 $\pm$ 8.4	88.9 $\pm$ 11	N.S.

$\pm$ S.D. = Standard deviation.

**Table 3** Pre-, post-, and final-test mean scores by provider subgroups ( $n=225$ )

Variables		Pre-test $\pm$ S.D.	$p$ -Value	Post-test $\pm$ S.D.	$p$ -Value	Final-test $\pm$ S.D.	$p$ -Value
Hospital workers	Yes	84 $\pm$ 11	$p=0.03$	92 $\pm$ 7	N.S.	90 $\pm$ 8	$p=0.002$
	No	80 $\pm$ 13		90 $\pm$ 9		85 $\pm$ 14	
Gender	Male	82 $\pm$ 12	$p=0.04$	91 $\pm$ 8	N.S.	89 $\pm$ 11	N.S.
	Female	85 $\pm$ 10		92 $\pm$ 7		90 $\pm$ 8	
Nurses		76 $\pm$ 12		85 $\pm$ 10		83 $\pm$ 15	
Cardiologists		83 $\pm$ 12		92 $\pm$ 6		91 $\pm$ 7	
Anaesthesiologists		89 $\pm$ 11	N.S.	93 $\pm$ 5	N.S.	88 $\pm$ 9	N.S.
General practitioners		84 $\pm$ 12		92 $\pm$ 8		90 $\pm$ 8	
Endocrinologists		96 $\pm$ 5		96 $\pm$ 4		96 $\pm$ 5	
Surgeons		83 $\pm$ 9		92 $\pm$ 5		87 $\pm$ 5	

$\pm$ S.D = Standard deviation.

even weeks, after a course.<sup>4-7</sup> The same findings have been observed with studies of lay rescuers, a very important link in the "chain of survival", as well as in studies of Advanced Trauma Life Support (ATLS) and Pediatric Advanced Life Support (PALS) providers.<sup>9,10</sup>

Simulation is a very important tool in medical and nursing training. Some studies have shown that simulation is superior to traditional lectures, visual learning, and the problem-based learning method.<sup>11,12</sup> Though high-fidelity simulations may be a very important tool for training, the retention of skills and knowledge is still poor.<sup>13</sup> Using actors to create a realistic environment can make scenarios more powerful and aid in retention. Live actors can interact with providers and, unlike any of the current high-fidelity manikins, can create a powerful, realistic environment. In this trial, live actors were used, and we evaluated knowledge improvement and retention; however, the use of live actors did not improve

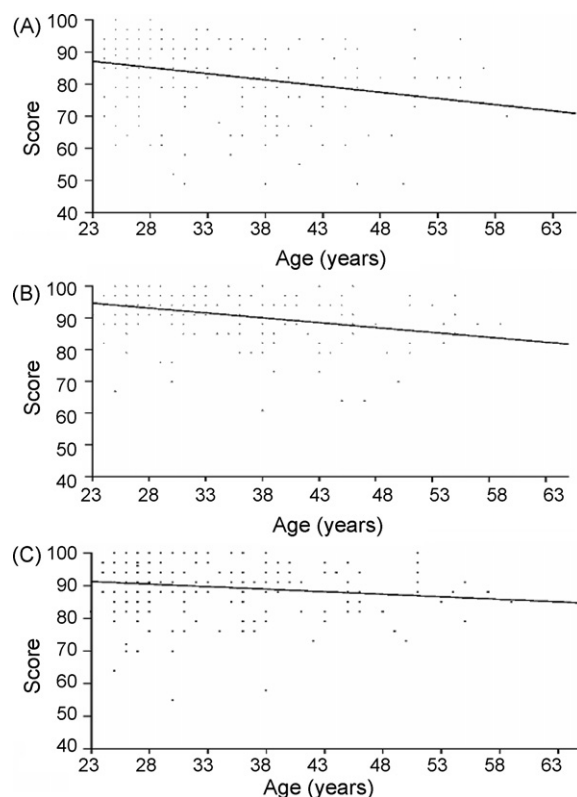
retention. Immediately after the course using live actors, all healthcare providers had improved knowledge (and probably skills), which shows that the use of live actors results in similar improvements to those seen with conventional manikins alone. On multivariate analysis, the use of live actors was not associated with worse scores.

Subgroup analyses showed that older healthcare providers and a longer interval since graduation from nursing or medicine were associated with lower scores. In contrast to other studies, no significant differences between medical specialties were found in knowledge improvement or retention.<sup>4,5,7</sup> In the present study, it was also found that healthcare providers who worked at hospital facilities had better pre-test (basic knowledge) and final-test (retention) scores than post-test scores; this suggests that they depended more on their previous knowledge to answer test questions. None of the other

**Table 4** Characteristics of study group (included in final analyses) and non-study group (not included in final analyses)

	Study group (%) or $\pm$ S.D.	Non-study group (%) or $\pm$ S.D.	$p$ -Value
Number	225 (51.7%)	210 (48.3%)	—
Age (years)	33 $\pm$ 9	32.7 $\pm$ 8.3	N.S.
Gender			
Male	130 (58%)	115 (55%)	N.S.
Female	95 (42%)	95 (45%)	
Time since graduation (years)	7.7 $\pm$ 8	7.9 $\pm$ 9	N.S.
Cardiologists	45 (20%)	28 (13%)	N.S.
General practitioners	116 (51.6%)	103 (49%)	N.S.
Anaesthesiologists	6 (2.7%)	7 (3.3%)	N.S.
Hospital workers	176 (78%)	156 (74%)	N.S.

$\pm$ S.D. = Standard deviation.



**Figure 2** Pre-test (A), post-test (B) and final-test (C) scores versus age (years).

variables was correlated with retention or improvement in scores after the course.

## Conclusions

Our data show that the use of live actors to increase scenario realism does not improve knowledge retention. No significant differences between medical or nurse specialties and by sex were observed. Older age and a longer interval since graduation were associated with the worst test scores and the worst knowledge retention. Working at hospital facilities was associated with better retention than working at other facilities.

## Limitations of the study

Up to 49% of the recruited participants were lost to follow-up at 6 months; however, their characteristics did not dif-

fer from those of the participants who completed all 3 tests.

## Conflict of interest statement

None.

## Acknowledgements

The authors would like to thank the volunteers who participated as live actors and all of the instructors and healthcare providers who agreed to participate in this study.

## References

1. Cummins RO, Ornato JP, Thies WH, Pepe PE. Improving survival from sudden cardiac arrest: the chain of survival concept. *Circulation* 1991;83:1832–47.
2. American Heart Association. Advanced cardiac life support. Instructor Manual. Medline, 2002.
3. Woollard M, Whitfield R, Smith A, Colquhoun M, Newcombe RG, Vetter N, et al. Skill acquisition and retention in automated external defibrillator (AED) use and CPR by lay responders: a prospective study. *Resuscitation* 2004;60:17–28.
4. Seraj MA, Naguib M. Cardiopulmonary resuscitation skills of medical professionals. *Resuscitation* 1990;20:31–9.
5. Quiney NF, Gardner J, Brampton W. Resuscitation skills amongst anaesthetists. *Resuscitation* 1995;29:215–8.
6. Stross JK. Maintaining competency in Advanced Cardiac Life Support Skills. *JAMA* 1983;249:3339–41.
7. Semeraro F, Signore L, Cerchiari EL. Retention of CPR performance in anaesthetists. *Resuscitation* 2006;68:101–8.
8. Bullock I. Skills acquisition in resuscitation. *Resuscitation* 2000;45:139–43.
9. Nadel FM, Lavelle JM, Fein JA, Giardino AP, Decker JM, Durbin DR. Teaching resuscitation to pediatric residents: the effects of an intervention. *Pediatrics* 2000;154(10):1049–54.
10. Blumenfeld A, Abraham B, Stein M, Shapira SC, Reiner A, Reiser B, et al. Cognitive knowledge decline after Advanced Trauma Life Support courses. *J Trauma* 1998;44:513–6.
11. Steadman RH, Coates WC, Huang YM, Matevosian R, Larmon BR, McCullough L, et al. Simulation-based training is superior to problem-based learning for the acquisition of critical assessment and management skills. *Crit Care Med* 2006;34:151–7.
12. Larew C, Lessans S, Spunt D, Foster D, Covington BG. Innovations in clinical simulations: applications of Benner's theory in an interactive patient care simulation. *Nurs Educ Perspect* 2006;27(1):16–21.
13. Moser DK, Coleman S. Recommendations for improving cardiopulmonary resuscitation skills retention. *Heart Lung* 1992;21:372–80.