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# Assessment of the knowledge level and its relevance in terms of CPR in medical personnel of the hospital emergency medical system of the Autonomous Community of the Region of Murcia

Valoración del nivel de conocimientos y su adecuación en materia de RCP en el personal sanitario de los servicios de urgencias hospitalarios de la Comunidad Autónoma de la Región de Murcia.

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Palabras clave: Reanimación cardiopulmonar; Conocimientos; Actitudes y Profesionales sanitarios.

## ABSTRACT

**Objective**. Cardiopulmonary resuscitation (CPR) is one of the most important hospital care team procedures to be administered by emergency medical services. There is a consensus as to cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations, which are regularly updated every five years. International recommendations advise health professionals to update their knowledge every two years. The objective of this paper is to discover health professionals' levels of knowledge as regards CPR, whether they are appropriately updated and to confirm whether the training courses on CPR performed improve health personnel's knowledge levels.

**Method**. A 20-question survey based on American Heart Association (AHA) and Spanish Society of Medicine and Intensive Care (SEMICYUC) recommendations was carried out.

**Results**. Evidence-based results strongly suggest that participants do not follow the international standards as regards training in CPR. Sixty four point seven percent of the participants attend at least one CPR course after 2010, but 10.1% never took a refresher course. Thirty percent of the faculties, 90% of the medical residents and 7% of the nursing staff did not obtain the training required by the AHA

in hospital emergency services (one course every two years). Our results show that the higher number of courses received, the higher is the level of knowledge regarding CPR that health staff obtain.

**Conclusions**: There is a need for new approaches as regards the learning methodology used in CPR courses. Our results show that healthcare staff are aware of the need to acquire knowledge on CPR via regular training.

## RESUMEN

**Objetivo**: La Reanimación Cardiopulmonar (RCP) es uno de los procedimientos de los equipos de asistencia hospitalaria más importantes que se realizan en los servicios de urgencias. Existe un consenso internacional sobre RCP, actualizándose cada 5 años, recomendándose la actualización de conocimientos cada 2 años para los profesionales. El objetivo de este estudio es conocer cuál es el nivel de conocimientos en RCP de los profesionales sanitarios, si estos profesionales están correctamente actualizados y constatar si la realización de cursos en el tiempo recomendado mejora el nivel de conocimientos.

**Método**: Realizamos una encuesta con 20 preguntas basada en los cuestionarios para valoración de conocimientos en RCP de la American Heart Association (AHA) y de la Sociedad Española de Medicina y Cuidados Intensivos (SEMICYUC).

**Resultados**: Obtuvimos como resultado que la totalidad de los encuestados no sigue los estándares internacionales de realización de cursos de actualización de conocimientos. El 64,7 % se actualizó después del 2010 y 10,1% nunca se actualizó. El 30% de los médicos, el 90% de los residentes y el 7% de los enfermeros, no superaban el umbral mínimo de formación establecido por la AHA en servicios de urgencias hospitalarias (un curso cada dos años). Se corrobora que a mayor realización de cursos mejor nivel de conocimientos.

**Conclusiones**: Resulta evidente la necesidad de cambios en la metodología de aprendizaje de los cursos impartidos en materia de RCP para profesionales. Destacamos que el personal sanitario sí esta concienciado de la necesidad de formación en esta materia.

## INTRODUCTION

During the 1930s, in Moscow, Negovsky (father of reanimation) created the first laboratory dedicated to research on Cardiopulmonary Resuscitation (CPR) (Cardio-pulmonary Reanimation). Negovsky developed models to study processes of exsanguinations and cardiac arrest in dogs. The knowledge obtained was successfully applied during the siege of Moscow in WWII. During the 1940s, he applied external chest compressions and defibrillation on dogs subjected to hypothermia, introducing the concepts of agonizing state, clinical death, and post-reanimation disease [(1)].

In 1962, Negovsky met with Peter Safar and other pioneers of reanimation to hold an international symposium, beyond the political restrictions imposed by the Cold War. That meeting conceptualized the Cardiopulmonary and Brain Reanimation System, whose application and methods were aimed at protecting the brain during circulatory arrest[(2)]. In 1963, Dr. Leonard Scherlis started the American Heart Association's reanimation committee and that same year CPR was formally approved [(3)].

The evolution of CPR since then until now has progressed increasingly fast due to the importance acquired and the large-scale actions to train physicians, paramedics, and laity in the application of vital pre-hospitalization and hospitalization support. Adequate CPR application requires big efforts and conciliation of interests, as well as human and economic resources[(4)].

International consensus exists since 2010 sponsored by the International Liaison Committee on Resuscitation (ILCOR), which has representatives from the highest scientific societies on CPR throughout the world: American Heart Association (AHA), European Resuscitation Council (ERC), Heart and Stroke Foundation of Canada (HSFC), Australian and New Zealand Committee on Resuscitation (ANZCOR), Resuscitation Council of Southern Africa (RCSA), Inter-American Heart Foundation (IAHF), and Resuscitation Council of Asia (RCA). These organisms are currently in charge of reviewing the clinical guides and protocols established globally. Its last update took place in 2010, when important modifications were added in the sequence and quality of the maneuvers to be performed[5,6]. Training and updating of health personnel working in emergency services is established every two years by AHA and ERC, the two most important organizations in North America and Europe.

According to Rosón *et al*.[7] the prognosis of cardiopulmonary arrest is proportional to the training of the personnel caring for the patient, and inversely proportional to the time that transpires between the cardiopulmonary arrest and the start of effective reanimation. Studies exist that assess the knowledge of health personnel on hospital protocols in case of cardiorespiratory arrest, which conclude on the need for CPR updates due to the low theoretical knowledge of the professionals[8-12]. However, to the extent of our knowledge, no references were found for studies assessing knowledge on Basic CPR (basic life support or BLS) and advanced CPR (Advanced life support or ALS) in hospital emergency units. With this study we sought to investigate the level of theoretical knowledge on BLS and ALS and their adequacy to the new guides drafted in 2010.

## METHODOLOGY

A cross-sectional and multicenter descriptive study was carried out. A sampling size was estimated adjusted to 15% losses in 408 professionals, with 95% confidence interval, 5% margin of error, and 50% level of heterogeneity. Random stratified sampling was performed of the professionals. The calculation based on the finite population formula for the study to be statistically significant was of 198 professionals.
The surveys were conducted between December 2012 and May 2013 in the hospital emergency services for adults of the hospitals of Murcian Health Service: Hospital de la Vega Lorenzo Guirao, Hospital General Universitario Reina Sofía, Hospital Rafael Méndez, Hospital Clínico Universitario Virgen de la Arrixaca, Hospital General Universitario Santa Lucía, Hospital General Universitario Los Arcos del Mar Menor, Hospital General Universitario Morales Meseguer, and Hospital Comarcal del Noroeste. A numerical code was assigned randomly to each hospital, given that the aim of the study was not to compare among hospitals.

This study was authorized by the Research Committee in Murcia's Hospital General Universitario Reina Sofía. The study population was comprised of: attending physicians who were doing permanent or sporadic shifts, resident physicians, and nurses from adult hospital emergency services. The study excluded all health personnel with experience of less than one month in said services and personnel from any category filling in specific substitutions.

To conduct the work, the members of the research group visited the emergency services of the different hospitals object of study, where they gave the questionnaires to the participants. In the presence of at least one researcher, the questionnaires were filled out individually by the participants, in wards different from their habitual place of

work, during a time period previously established with the participants, generally between 20 and 30 minutes. Upon finishing the questionnaire, such was collected and handed over to the principal investigator for its analysis and custody. To gather the data, the study used a questionnaire based on the "2010 Guidelines of the American Heart Association for CPR and ECC"[6], which was validated in its reading comprehension by an initial sample of 15 participants. These questionnaires were excluded from the subsequent analysis of the data to obtain the study results. Table I shows the final questionnaire after the validation process.

**Table I**. Questionnaire on CPR knowledge

**Evaluation Questionnaire of CPR Knowledge for Health Personnel from Emergency Service**

Do not mark your answers on this page. Indicate the correct answer on the separate answer sheet. Please, mark the response you believe is right. If you do not which is correct, mark the one you consider could be the most adequate. Only one answer per question.

1. To apply basic high-quality CPR, according to the new recommendations, we should: (indicate the incorrect choice)
a. Permit full chest expansion after each compression.
b. The depth of the compressions must be at least 5 cm in adults.
c. Reduce to a minimum interruptions of chest compressions.
d. Ventilation takes the leading role with respect to chest compressions.

2. What is the correct sequence of the BLS steps, according to the 2010 AHA guidelines?
a. A-B-C [Airway, Breathing, Chest compressions].
b. C-A-B [Chest compressions, Airway, Breathing].
c. C-B-A [Chest compressions, Breathing, Airway].
d. B-C-A [Breathing, Chest compressions, Airway].

3. What mistake is common and sometimes deadly during the treatment of cardiac arrest?
a. Not obtaining vascular access
b. Prolonged periods without ventilations
c. Not performing endotracheal intubation
d. Prolonged interruptions of the chest compressions

4. What action is part of high-quality chest compressions?
a. Guarantee full chest compression
b. Administer chest compressions without ventilation
c. Administer between 60 and 100 compressions per minute with a ratio of 15:2
d. Administer continuous compressions with a depth of 3.75 cm.
5. What is the situation that best describes electric activity without pulse?
a. Asystole without pulse
b. Sinus rhythm without pulse
c. Torsades de pointes with pulse
d. Ventricular tachycardia with pulse.

6. Which is the best strategy to perform high-quality CPR on a patient with an advanced device for the airway?
a. Administer compressions and ventilations with a ratio of 15:2

b. Administer compressions and ventilations with a ratio of 30:2
c. Administer only one ventilation every six seconds during compression pause.
d. Administer continuous chest compressions without pause and 10 ventilations per minute.

7. Using capnography in intubated patients...
a. Permits supervising the CPR quality
b. Measures the oxygen levels in the alveoli
c. Determines the level of inspired carbon dioxide in relation to the cardiac output
d. Electrolyte abnormalities are detected early during code management

8. What practice is safe and effective in the defibrillation sequence?
a. Stop chest compressions when loading the defibrillator.
b. Make sure no oxygen is circulating in patient's chest during discharge.
c. Determine the presence of pulse immediately after discharge.
d. Announce imperatively "clear" after administering the charge with the defibrillator.

9. What medication and in what dosage is it recommended to treat a patient with persistent ventricular fibrillation?
a. 2 mg atropine
b. 300 mg amiodarone
c. 1 mg/kg vasopressin
d. 2 mg/kg per minute of dopamine

10. What is the appropriate interval to interrupt chest compressions?
a. 10 seconds or less
b. From 10 to 15 seconds
c. From 15 to 20 seconds
d. Interruptions are not acceptable under any circumstance

11. What action improves the quality of chest compressions administered during a reanimation attempt?
a. Observe the ECG rhythm to determine compression depth
b. Prevent full chest decompression with each compression
c. Perform compressions on the upper half of the sternum with a frequency of 150 compressions per minute.
d. Switch resuscitation staff every two minutes or every five cycles of compression

12. Which is the adequate ventilation strategy for an adult with respiratory arrest and pulse frequency of 80 bpm?
a. One ventilation every 3 or 4 seconds
b. One ventilation every 5 or 6 seconds
c. Two ventilations every 5 or 6 seconds
d. Two ventilations every 6 or 8 seconds

13. A patient with respiratory insufficiency is apneic, but continues having a strong pulse. Cardiac frequency drops suddenly to 30 bpm. Which intervention has the highest priority?

a. Iv bolus atropine
b. Iv infusion of adrenalin
c. Application of transcutaneous pacemaker
d. Simple maneuvers of airway and assisted ventilation.

14. What rhythm requires synchronized cardioversion?
a. Unstable supraventricular tachycardia
b. Ventricular fibrillation
c. Sinus tachycardia
d. Normal sinus rhythm on monitor, but with lack of pulse

15. Which tends to be the range of PETCO2 target values after cardiac arrest when ventilating a patient in whom we achieve return of spontaneous circulation (RSC)?
a. From 30 to 35 mmHg
b. From 35 to 40 mmHg
c. From 40 to 45 mmHg
d. From 45 to 50 mmHg

16. What is the most reliable method to confirm and monitor the correct location of an endotracheal tube?
a. Five-point auscultation
b. Colorimetric capnography
c. Continuous capnography
d. Use of esophageal detectors

17. If we have a manual defibrillator monitor, the initial monitoring of cardiac activity in a patient who has just had CRA witnessed must be performed in the following manner:
a. Turn on defibrillator monitor, select derivation II and monitor with paddles.
b. Turn on defibrillator monitor, select derivation II and monitor with adhesive electrodes placed on chest.
c. Turn on defibrillator monitor, select derivation II and monitoring with adhesive electrodes placed on limbs.
d. Perform 12-derivation ECG.

18. Regarding CPR maneuvers, indicate the incorrect response:
a. The compression-ventilation ratio in an adult is 30:2
b. If there is no breathing and no pulse, start by administering two ventilations
c. Two reanimation staff upon a CRA in a breastfeeding woman will use a ratio of 15:2
d. Cardiac massage has to be early and continued

19. You are caring for a person in CRA. Upon the rhythm observed on the monitor you doubt between VF and asystole. Indicate the correct action.
a. Upon doubt act as VF.
b. Upon doubt act as asystole.
c. Upon doubt act as asystole and reevaluate the rhythm at the minute.
d. Upon doubt adrenalin helps the differential diagnosis.

20. We are upon a woman 8-months pregnant in CRA and ventricular fibrillation, what action should we take?

a. Only perform Basic CPR, given that administering medications and defibrillation are contraindicated during pregnancy
b. Perform Advanced CPR without defibrillating, it is contraindicated during pregnancy
c. Perform Basic CPR instrumented with SAED, we cannot administer medications to a pregnant woman.
d. Perform Advanced CPR, as if she were not pregnant

The anonymous questionnaire had two parts. The first gathered demographic variables and social and labor information: age, gender, professional category, years of work experience (grouped into 5-year intervals), years of experience in emergency services (grouped into 5-year intervals), number of training courses related to CPR, and date of last course taken on the subject of CPR. The second part had 20 test-type questions on CPR, with four possible responses, with only one correct possibility, where we explored the knowledge of the professionals regarding BLS (six questions) and ALS (14 questions). Among the questions seven referred explicitly to aspects updated in the 2010 clinical practice guide on CPR by the AHA, both for BLS and ALS. We consider the questionnaire has been passed when the percentage of correct answers exceeds 50%. In the instructor guides for Advanced CPR by AHA-SEMES passing requires 80% of the questionnaire answered correctly (this was kept in mind in some of the results analyzed). After collecting the data, these were tabulated on a Microsoft Excel document, carrying out matrix tables and were then migrated for their statistical analysis with IBM's SPSS Statistics 19 program.

Descriptive statistics were conducted, presenting frequencies and percentages for the qualitative variables, as well as means and standard deviations for the quantitative variables. In the hypothesis contrast, for quantitative dependent variables, we applied Student's t to compare two samples, and the one-factor ANOVA to compare more than two groups. To apply these parametric tests, the distribution normality of a sample was tested via the Kolmogorov-Smirnova test or the Shapiro-Wilk test, and the equal variances via Levine's test. Whenever possible, in cases where restrictions were not fulfilled to apply the parametric tests, a logarithmic transformation was applied to the study variable. Lastly, nonparametric tests were used: the Mann-Whitney U test to compare two samples and the Kruskal-Wallis contrast test to compare more than two samples. For qualitative dichotomous dependent variables binary logistic regression was used, applying Wald's test and calculating the odds ratio (OR).

## RESULTS

The sample was made up of 198 health workers who completed the survey. A total of 27% participation was achieved from health personnel in the emergency services of the public hospitals from the Murcia region. Of the 198 surveys, 71 were taken by attending physicians (36%), 35 by residents from different years (18%) and 92 by nurses (46%). The sociodemographic characteristics of the simple are shown in Table II.

**Table II. Characteristics of the sample according to sociodemographic variables, work experience, formation, and passing the questionnaire**

| Sociodemographic variables, work experience, and formation | Characteristics of the sample: N (%) |
|---|---|
| **Age** | |

| | |
|---|---|
| 26-30 | 50(25.3) |
| 31-35 | 60(30.3) |
| 36-40 | 39(19.7) |
| 41-45 | 23(11.6) |
| 46-50 | 10(5.1) |
| 51-60 | 14(7.1) |
| >60 | 2(1.0) |
| **Gender** | |
| Male | 76(38.4) |
| Female | 122(61.6) |
| **Professional category** | |
| Nurses | 92(46.5) |
| Physicians | 71(35.9) |
| Residents | 35(17.7) |
| **Years of work experience in health services** | |
| <1 | 14(7.1) |
| 1-5 | 36(18.2) |
| 6-10 | 65(32.8) |
| 11-15 | 42(21.2) |
| 16-20 | 22(11.1) |
| >20 | 19(9.6) |
| **Years of work experience in an emergency service** | |
| <1 | 27(13.6) |
| 1-5 | 72(36.4) |
| 6-10 | 53(26.8) |
| 11-15 | 20(10.1) |
| 16-20 | 15(7.6) |
| >20 | 11(5.6) |
| **Number of courses taken** | |
| 0 | 16(8.1) |
| 1 | 32(16.2) |
| 2 | 55(27.8) |
| 3 | 38(19.2) |
| 4 | 25(12.6) |
| 5 | 19(9.6) |
| 6 | 11(5.6) |
| >6 | 2(1.0) |

The mean of correct responses was 11.0 (SD 2.9) in physicians, 9.1 (SD 2.6) in residents, and 8.8 (SD 3.5) in nurses, finding significant differences, $F(2, 195) = 11.3$, ($p < 0.001$), between physicians and residents ($p < 0.001$), and between physicians and nurses ($p < 0.001$). The results were analyzed per group of questions – BLS, ALS, and update questions, only finding differences in the questions about knowledge on ALS (Kruskal-Wallis $H = 24.3$, $gl = 2$, $p < 0.001$), among the professional categories mentioned.

To study the effect of the professional category on passing the test of knowledge on CPR, ALS, BLS, and update questions, it was considered that a subject passed a part of the test upon getting a score equal to or greater than five (for the full CPR test, it meant answering correctly 10 or more of the 20 questions). A total of 51.5% passed the CPR test, 52.5% the BLS part, 56.1% the ALS part, but only 35.4% passed the

update questions. Table III shows the passing distribution in CPR, BLS, ALS, and update questions according to the professional category.

**Table III. Passing the complete questionnaire, BLS, and ALS according to the professional category**

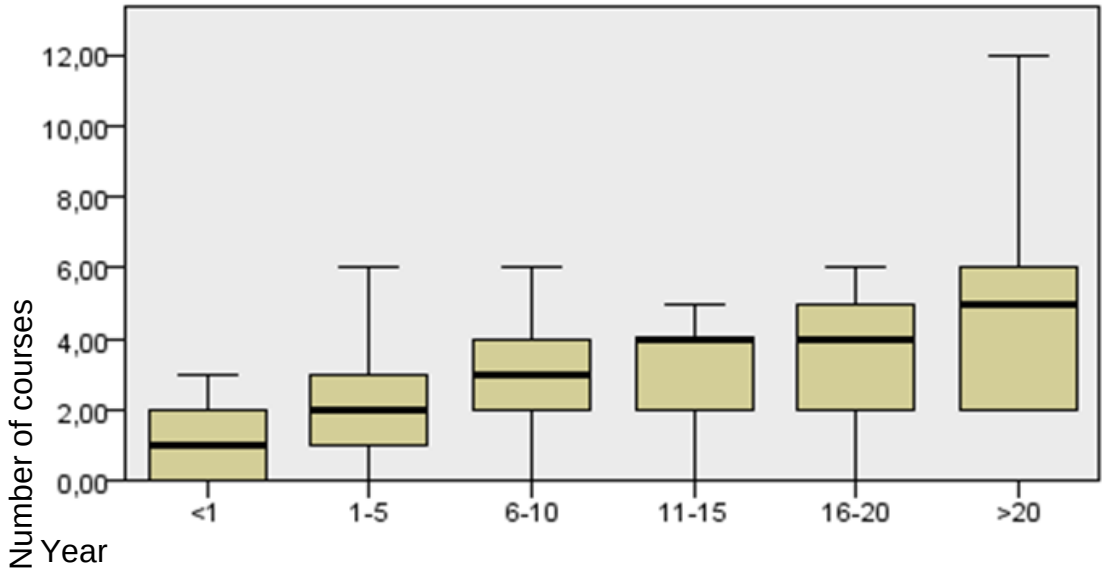
| Variables of passing the questionnaire | Sample broken down according to the questionnaire passed: N (%) | |
|---|---|---|
| **Passed 50% of the questionnaire per professional category** | **Passing** | **Not passing** |
| Nurses | 35(37.6) | 58(62.3) |
| Physicians | 51(72.8) | 19(27.1) |
| Residents | 16(45.7) | 19(54.2) |
| **Passed 50% BLS questions per professional category** | | |
| Nurses | 44(52.6) | 49(47.3) |
| Physicians | 43(38.5) | 27(61.4) |
| Residents | 17(48.5) | 18(51.4) |
| **Passed 50% ALS questions per professional category** | | |
| Nurses | 39(41.9) | 54(58.0) |
| Physicians | 52(74.2) | 18(25.7) |
| Residents | 20(57.1) | 15(42.8) |
| **Passed 50% update questions per professional category** | | |
| Nurses | 64(68.8) | 29(31.1) |
| Physicians | 43(61.4) | 27(38.5) |
| Residents | 21(60.0) | 14(40.0) |
| **Passed 50% of the questionnaire in relation to the update year** | | |
| <2010 | 30(42.8) | 40(57.1) |
| 2010 | 16(40.0) | 24(60.0) |
| 2011 | 20(57.1) | 15(42.8) |
| 2012-2013 | 36(67.9) | 17(32.0) |

In CPR, significant differences were noted between nurses and physicians (OR = 4.4, CI95%: 2.2-8.7), but not between physicians and residents (OR = 1.3, CI95%: 0.6-3.0). The study on BLS and update questions did not reveal significant differences. On the contrary, in ALS statistically significant differences were noted between physicians and nurses (OR = 4.0, CI95%: 2.0-7.8), but not between physicians and residents (OR = 1.8, CI95%: 0.8-4.0). If the threshold of the passing score is equal to or greater than 8, the differences among the professional categories remain, but sensibly decreasing the percentages of the participants who pass, 3.0% in CPR, 8.1% in BLS, 10.6% in ALS, 7.1% in the update questions.

The study inquired if work experience and experience in emergency services impacted upon CPR knowledge. No significant differences were found among the subjects from different intervals of years of work experience $F(5, 192) = 1.9$ ($p < 0.05$). On the contrary, the study revealed that experience in emergency services did determine CPR knowledge CPR (Kruskal-Wallis $H = 19.5$, $gl = 5$, $p < 0.01$). Concretely, differences were found between the subjects with work experience of less than six years in emergency services and the rest of the groups. These results suggest that at least six years are required of working practice in emergency services to reach the

maximum level of CPR knowledge. Figure 1 shows a box diagram reflecting the dispersion of courses taken by those surveyed in the six intervals of years of experience in emergency services analyzed.

**Figure 1**. Multiple box diagram of courses taken according to the years of experience in emergency services




Training in CPR is a fundamental element for healthcare professionals in emergency services. A total of 15.6% of those surveyed took more than four CPR courses, 12.6% took exactly four courses, 19.2% took three courses, 26.3% took two courses, 16.2% took one course, and 10.1% took no courses. With respect to the year of the last update, most of the professionals surveyed (64.7%) had taken their last CPR course between 2010 and 2013, 25.2% prior to 2009.

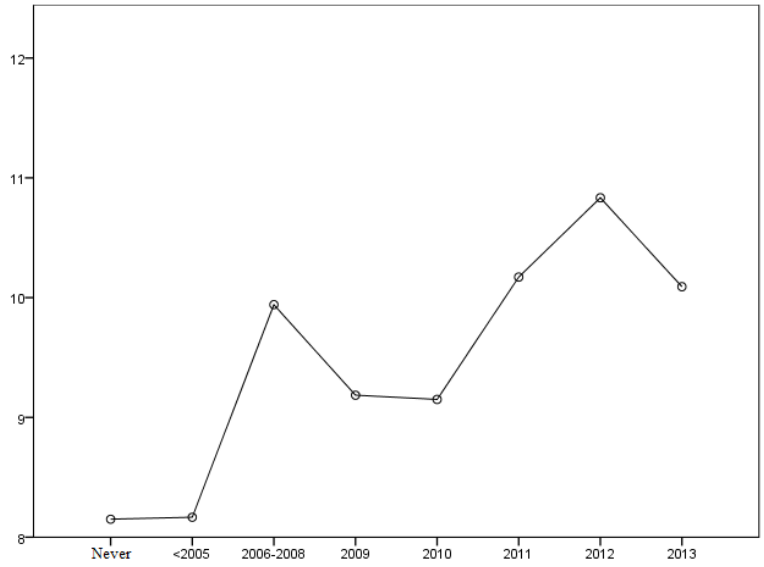
This study found that years of work experience (Kruskal-Wallis H = 36.4, gl = 5, $p < 0.001$), years of experience in emergency services (Kruskal-Wallis H = 51.9, gl = 5, $p < 0.001$), and professional category (Kruskal-Wallis H = 30.0, gl = 2, $p < 0.001$) have an effect on the number of CPR courses taken. In all cases, a greater number of years of experience, or professional categories with more work experience led to a higher number of courses. Specifically, the mean number of courses taken by physicians was 3.6, by residents 1.5, and by nurses 2.6.

According to the 2010 AHA CPR and ECC[6], the minimum updating required for healthcare professionals is every two years. The number of courses each subject surveyed should have taken was calculated according to this standard and it was compared to the number of CPR training courses taken according to survey responses. A total of 21.2% of the subjects did not reach the suggested number of courses according to their work experience. Precisely, 30% of the physicians, 95% of the R4 residents, 89% of the R3 residents, 92% of the R2 residents, 89% of the R1 residents, and 7% of the nurses did not exceed the minimum formation threshold.

Although it is true that these results offer a historical perspective of the professionals regarding their formation, the most recent international recommendations on CPR by the AHA and ERC were published in 2011. Its update added important modifications in the sequence and quality of the maneuvers to perform. To consider this factor, the sample was divided into two groups of subjects, according to whether they had or had

not taken a CPR course after 2011. Significant differences were observed between both groups on the level of CPR knowledge $t(196) = 2.5$ ($p < 0.05$), ALS $t(196) = 2.5$ ($p < 0.05$) and update questions $t(196) = 24.4$ ($p < 0.05$), but not on BLS, $t(196) = 1.4$ ($p = 0.14$). Figure 2 shows that the highest mean scores in the survey were obtained by the healthcare professionals who had taken a CPR course since 2011. As shown in table III, the percentage of those passing (a score equal to or greater than 5) is sensibly higher in the healthcare professionals who had taken a CPR course as of 2011.

**Figure 2**. Mean test scores according to the year of the last CPR course taken




## DISCUSSION

In light of the data exposed, we can state that the CPR knowledge of the professionals surveyed is acceptable. According to a survey conducted by Hopstock[13], working in services with high risk of finding a hemodynamic situation compromising the patient's health, provides greater motivation to healthcare professionals to receive more formation in this area of study. However, sensible differences exist among the different professional categories, as confirmed by another survey conducted in hospital emergency services by Montes *et al*.[14]. The percentage of nurses who passed the test (37.6%) is low. Some prior studies[8, 12] have confirmed similar percentages, while another survey carried out in Spain by Castillo-Garcia *et al*.[15] found a higher level of CPR knowledge (6.7) among hospital nursing staff. For the residents, our results reveal that their CPR knowledge is slightly higher (45.7%) than that of the nursing professionals. Nevertheless, this level of knowledge turns out insufficient, in line with another recent survey conducted by Kyriakou *et al*.[16] in a Greek hospital. As found in a survey by Hayes *et al*.[17], residents perceive that for their preparation it is deficient and that they are not prepared to lead CPR teams. To increase confidence levels of healthcare professionals, simulations are proposed to reduce stress levels of resident[18] and nursing[19] personnel, characteristic of critical situations with real patients.

Knowledge by physicians is significantly higher (72.5% passed the test, with a mean of 5.5 points), finding slight differences against another survey conducted by Castillo-

Garcia *et al*.[15], (5.9 points on a scale from 0 to 10). The origin of these results could lie in the higher number of years of academic formation and probably higher availing of training courses by the attending physicians. Some studies have found higher indices of survival in patients with cardiac arrest when intervened by experienced physicians in the multidisciplinary team caring for the patient[20, 21], against other teams comprising only paramedics[22, 23].

Concern is noted on professional continuous formation, given that 78.7% of those surveyed takes a refresher course every two years, the ratio required to comply with the formation parameters by international organizations. As stated by Montes *et al*., heath care professionals are aware of the need for formation[14], even claiming obligatory periodic teaching[15]. In our study, the highest peaks in taking training courses coincide with the years after the modifications of CPR protocols by the international organizations (20.2% of those surveyed received their last training course in 2010, and 21.1% received their last training course in 2012). Note that 93% of the nurses exceeded the minimum formation threshold (one course every two years), probably motivated by their being the closest professionals (in terms of space and time) to the patients, as indicated by Passali *et al*.[12] and, hence, in being the first heath care professionals in attending a cardio-respiratory arrest. It has been demonstrated that recent training, that is, taking a training course within the last two years[14], or within the last six months[16], is a good predictor of having skills in CPR. However, the nurses surveyed did not reach good scores in CPR. Most of the nurses surveyed have temporary contracts and undergo great pressure to take courses that allow them to secure work promotions. On the contrary, less than 10% of the resident physicians received the training suggested by international standards. Hunt *et al*. have conducted observational prospective studies with pediatric residents who show shortcomings in compression and defibrillation, not reaching the standards established by AHA[24], especially among R1 and R2 residents [25].

If we were to follow the quality parameters by international organizations (passing with 80% correct answers), we would find very high passing levels. This supports a prior study by Su *et al*.[26], which demonstrates that after six months of the training, an evident decrease is noted of the knowledge acquired in CPR. Besides, another one of the problems to solve is the methodology used during the training. The literature found reflects the need for training in BLS and ALS, by using experience-based learning [27]. Studies by Kidd *et al*. And Bellan *et al*. have shown that theoretical-practical training is more effective that merely theoretical formation[28, 29]. In addition, the results of a study conducted by Jensen *et al*.[30] show that no difference exists between the formation carried out by ERC and by AHA, regarding student knowledge immediately after the formation.

Recent studies advocate the combined use of theoretical-practical training and new technologies on CPR formation, but the results obtained are still not significant. Lo *et al*.[31] showed that combining high-reliability simulation systems (informatics simulators on CPR actions) did not imply higher levels of retention of knowledge after one year compared to the theoretical-practical methodology used currently for formation by AHA and ERC. Perkins *et al*.[32] also did not find evidence to indicate that combined use of e-learning and classroom formation produced a difference in the theoretical results, although it did lower costs, compared to the current methodology. However, use of direct mailings to physicians to keep them informed of developments in CPR and send reminders resulted effective to increase theoretical knowledge on the subject, according to a study by Secher *et al*.[33].

Currently in the Murcia region, the Persephone Program[34] has been begun; its objectives include: to obtain a high level of quality in CPR teaching and efficiently use public resources for formation in this topic. Within this program, the lack of policies in human resources has been highlighted as a weakness of the system for personnel selection by using competency profiles.

This study presented some limitations, which need to be commented. The first is the selection bias. Although we sought to have the maximum number of surveys during the time the study was carried out, we obtained 27% participants from the total number of personnel in the hospital emergency services. We must, therefore, presuppose that those who answered have a greater interest in CPR and are more aware of the need for training than those who did not. The second is that in spite of the number of surveys collected, upon classifying them in function of the professional characteristics studied, in some group the representation can be scarce. Notwithstanding these limitations, we do not believe the validity of the conclusions, as a whole, are altered.

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