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Factors influencing the level of knowledge of cardiopulmonary resuscitation in hospitals in Peru☆

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ABSTRACT

Introduction: Worldwide, the incidence of cardiopulmonary arrest is 20–140 per 100,000 people, with an alarmingly low survival rate of approximately 2–11%. Effective cardiopulmonary resuscitation (CPR) is required in order to improve this situation.
Objective: To determine the association between social and education factors and the level of knowledge of CPR among healthcare staff in hospitals in Peru.
Methodology: A multi-centre, cross-sectional analytical study was conducted based on convenience sampling among healthcare workers in 25 hospitals in Peru, using questionnaires validated for the local population. Bi-variate and multi-variate statistics were calculated using generalised linear models.
Results: Of 1075 people surveyed, 52% were females, the mean age was 33, 77% were physicians, 61% had attended national universities, and 62% had taken a first aid course/workshop. Of them, 59% failed the CPR test. Having spent a longer number of hours in the emergency service (OR: 1.003; 95% CI: 1.002–1.004; $p < 0.001$), being a physician (OR: 1.51; 95% CI: 1.13–2.03; p: 0.027) or being a nurse (OR: 1.45; 95% CI: 1.10–1.93; p: 0.001), was associated with good knowledge of CPR, adjusted for prior attendance to a CPR course, and for the place of work of the individual respondent.

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Conclusion: The level of knowledge was low and this is something that needs to be considered when developing continuing education policies in order to ensure that the healthcare staff has updated knowledge, and is prepared, in theory and in practice, to avoid complications and fatal outcomes.

Factores asociados al nivel de conocimiento en reanimación cardiopulmonar en hospitales del Perú

Palabras clave:
Resucitación cardiopulmonar
Urgencias médicas
Personal de salud
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RESUMEN

Introducción: A nivel mundial el paro cardio-respiratorio tiene una incidencia entre 20–140 por 100,000 personas, con una supervivencia alarmante, del 2–11% aproximadamente. Se requiere que la reanimación cardiopulmonar (RCP) deba ser efectiva para mejorar esta situación.

Objetivo: Determinar la asociación entre los factores socio-educativos y el nivel de conocimiento sobre RCP en el personal de salud de hospitales peruanos.

Métodología: Se realizó un estudio transversal analítico multicéntrico, con un muestreo por conveniencia a profesionales de la salud de 25 hospitales del Perú, mediante encuestas validadas en población local. Se calculó la estadística bi y multivariada con los modelos lineales generalizados.

Resultados: De los 1075 encuestados, el 52% fueron mujeres, la mediana de edades fue de 33 años, el 77% fueron médicos, el 61% estudiaron en universidades nacionales y el 62% llevó previamente un curso/taller de primeros auxilios. El 59% desaprobó el test de RCP. Estuvo asociado a tener un buen conocimiento de RCP el pasar una mayor cantidad de horas en el servicio de emergencias (RPa: 1,003; IC95%: 1,002–1,004; $p < 0{,}001$), el ser médico (RPa: 1,51; IC95%: 1,13–2,03; p: 0,027) o el ser enfermera (RPa: 1,45; IC95%: 1,10–1,93; p: 0,001), ajustado por el haber llevado previamente un curso de RCP y la sede de encuestado.

Conclusión: El nivel de conocimiento fue bajo, esto debe ser considerado para generar políticas de actualización y educación continua, para que el personal de salud esté preparado en la teoría y práctica, pudiendo así evitar complicaciones y muertes.

Introduction

At present, cardiovascular diseases (CVD) are considered a public health problem worldwide. Many times, adults present with sudden cardiac arrest (SCA) as the only symptom.[1,2]

The incidence of SCA outside the hospital ranges between 20 and 140 for every 100,000 people in the world, and survival ranges between 2 and 11%.[3] In the United States and Canada, the incidence is approximately 50–55 for every 100,000 people, occurring as a result of coronary heart disease in more than 60% of the cases reported.[1] In Peru, the actual incidence of sudden death and its causes are unknown, although there are some case reports.[4]

The importance of having the knowledge to start immediate cardiopulmonary resuscitation (CPR) has been proven, in particular when performed by trained healthcare professionals, improving survival of in-hospital CA in 7–24% of reported cases.[5] The American Heart Association (AHA) recommends CPR training for physicians every 2 years,[6] considering that there are groups with low competency in CPR because skills decline,[5] giving rise to a poor technique[7] with the resulting consequences for the individual with SCA.[8]

High-quality CPR influences survival following SCA, as long as the five essential components are performed appropriately: minimising interruptions of chest compressions, performing chest compressions with adequate frequency and depth, achieving complete chest expansion between compressions, and avoiding excess ventilation.[3] It is often the case that victims fail to receive high-quality CPR because of hesitancy of the healthcare professional when it comes to prioritising resuscitation efforts during cardiac arrest (do not resuscitate orders and anaesthesia). A local study found that 80% of the general practitioners recognised not being sufficiently prepared to provide CPR, when considering only their undergraduate medical training.[6]

Although there are institutions that provide training on the correct use, there are still knowledge gaps and deficiencies in the application of the CPR technique.[4,9] Hence the need to analyse the current CPR knowledge status in Peruvian hospitals in order to identify weaknesses and work on solutions.

The objective of the study was to identify the factors that determine CPR knowledge in hospitals in Peru.

Methodology

Study design and population

Multi-centre, cross-sectional, analytical study conducted between September 2014 and March 2015 based on convenience surveys given to healthcare staff in 25 hospitals in Peru. The population included full-time healthcare workers at each hospital who agreed to participate voluntarily. Moreover, nine hospitals located in the capital city (Lima) and 13 provincial hospitals (Piura, La libertad, Ucayali, Cusco) were included. Incomplete questionnaires or those with no answers to knowledge questions were excluded (25 questionnaires). The map in Fig. 1 shows the hospitals by location.

Variables

The main variable was the level of CPR knowledge which was measured using a questionnaire consisting of 20 multiple-choice questions, previously validated for our setting.[10] For the statistical analysis, the group with the best ratings (upper tertile) was compared with the group without them (middle and lower tertiles added). Respondents that were rated in the upper tertile were considered to have good knowledge (category of interest).

Secondary variables were gender, age, marital status, type of hospital, university of undergraduate education, year of enrolment in the university, year of completion of university studies, and participation in training courses on basic CPR techniques. People who were healthcare professionals were also asked about the number of years in their institution, type of professional, specialty, area of work in the hospital, and average number of work hours in the emergency service per month.

Procedures

Knowledge evaluation questionnaire

Questions designed to measure the level of knowledge of CPR were included (20 questions, including the socio-academic ones). These were multiple-choice and single answer questions. Independent variables were social and education included in the questionnaire and they were crossed to determine associations with those variables.

Data collection

Each hospital was asked for permission to conduct the study. Once permission was obtained, the survey was given in each of the hospitals, consisting of institutions located in different departments of Peru and assigned to the Ministry of Health (MINSA), the Social Security System (EsSalud) and the Armed Forces.

All the interviewers were instructed on the correct administration of the questionnaire and were given the response sheets for common questions to the interviewees. After the surveys were given, the data were entered in an Excel database (version 2010 for Windows). One of the authors performed quality control of all the databases and pulled them together for the statistical analysis.

Fig. 1 – Locations of the hospitals that participated in the study. Guillermo Almenara Irigoyen National Hospital,[1] Edgardo Rebagliati Martins National Hospital,[2] Ate-Vitarte Emergencies Hospital,[3] Belén de Trujillo Hospital,[4] Daniel Alcides Carrion National Hospital,[5] Sergio E. Bernales Hospital (Collique),[6] Level II Pucallpa-Essalud Hospital,[7] Dos de Mayo National Hospital,[8] Santa Rosa-Piura Level I Support Hospital,[9] Hipólito Unanue National Hospital,[10] Adolfo Guevara Velasco-Essalud National Hospital, Cusco,[11] Cusco Regional Hospital,[12] Madre Niño San Bartolome National Teaching Hospital,[13] Yarinacocha Amazon Hospital,[14] Trujillo Regional Teaching Hospital,[15] José Cayetano Heredia-Regional Hospital, Piura,[16] Víctor Lazarte Echegaray National Hospital, Trujillo,[17] Arzobispo Loayza National Hospital,[18] Central Police Hospital,[19] Hospital Regional Lambayeque-Chiclayo Regional Hospital,[20] Alberto Sabogal Sologuren National Hospital,[21] HAMO,[22] HEJCU,[23] Coronel Luis Arias Schreiber Central Military Hospital,[24] Sullana Level II Support Hospital.[25]
***Source*: Authors.**

Data analysis

The data were processed using the Stata version 11.1 software package (Stata Corp., TX, USA). Quantitative variables were presented as medians and ranges (because of prior assessment using the Shapiro–Wilk statistical test), while categorical data were processed as frequencies and percentages.

A significance level of 95% was considered for the bivariate and multivariate analyses. Generalised linear models were used for raw prevalence ratios (rPR), adjusted prevalence ratios (aPR), their 95% confidence intervals (95% CI) and *p* values,

applying the *Poisson* family and log link function, and the site where the measurement was performed was used as cluster (in order to take into account differences among the various groups assessed). *p* values <0.05 were considered as statistically significant.

Ethical considerations

The survey was self-administered and all respondents provided verbal consent after receiving an explanation of the purpose of the research from the interviewers. The protocol was approved by the Ethics Committee of the National San Bartolomé Hospital (Communication N°: 0321-DG-OADI-N° 085-HONADOMANI-SB-2014).

Results

Out of 1075 respondents, 51.6% (545) were female and the median age was 30 years (range 20–86). Descriptive values are shown in Table 1.

Overall, 59.0% (634) had poor knowledge of CPR. The best ratings were obtained by the nurses (63%), followed by physicians (51%), medical interns (35%) and medical residents (33%) (Fig. 2).

The bivariate analysis showed that spending more hours in the emergency service (rPR: 1.004; 95% CI: 1.002–1.005; *p* < 0.001), being a physician (rPR: 1.41; 95% CI: 1.04–1.91; *p*: 0.027), being a nurse (rPR: 1.65; 95% CI: 1.21–2.23; *p*: 0.001) and having taking a CPR course (rPR: 1.84; 95% CI: 1.15–2.93; *p*: 0.027), were associated with having good knowledge of CPR (Table 2).

The multivariate analysis showed that spending more hours in the emergency service (aPR: 1.003; 95% CI: 1.002–1.004; *p* < 0.001), being a physician (aPR: 1.51; 95% CI: 1.13–2.03; *p*: 0.027) or being a nurse (aPR: 1.45; 95% CI: 1.10–1.93; *p*: 0.001), was associated with having good knowledge of CPR, adjusted for having taken a prior course in CPR and respondent work site (Table 3).

Table 1 – Social and education characteristics of the respondents in 25 hospital sites in Peru.

Variable	*n*	%
Sex		
Female	545	51.6
Male	511	48.4
Age (years)[a]	30	20–86
Year of enrolment for university studies[a]	2004	1945–2014
Year of completion of university studies[a]	5	63–0
Graduated from National University		
Yes	606	60.9
No	389	39.1
Profession/occupation		
Physician	311	30.1
Intern	407	39.4
Nurse	129	12.5
Resident	81	7.9
Other	104	10.1
Hours spent in emergency service[b]	72	0–360

[a] Median and range.
[b] Monthly average.
Source: Authors.

Discussion

At present, cardiovascular diseases are the group of diseases with the greatest social impact, given their significance in terms of sudden death and cardiopulmonary arrest.[8] They require immediate effective intervention based on adequate knowledge and practical skills for resuscitation,[9–12] because

Table 2 – Bivariate analyses of successful CPR test according to social and education variables of the healthcare staff in 25 hospital sites in Peru.

Variable	Good knowledge of CPR N (%)		rPR (95% CI)	*p* value
	Si	No		
Female sex	167 (50.0)	378 (52.6)	0.87 (0.72–1.05)	0.154
Age (years)[a]	30 (20–60)	29 (20–86)	1.00 (0.99–1.01)	0.950
Year of enrolment[a]	03 (72–10)	04 (45–14)	0.99 (0.98–1.02)	0.939
Year of completion[a]	09 (78–17)	10 (52–17)	1.00 (0.98–1.01)	0.710
Hours in emergency service	150 (0–360)	52.5 (0–360)	**1.004 (1.002–1.005)**	**<0.001**
National University	235 (72.8)	371 (55.2)	1.38 (0.97–1.95)	0.069
Profession/occupation[b]				
Physician	124 (37.9)	187 (26.5)	**1.41 (1.04–1.91)**	**0.027**
Intern	110 (33.6)	297 (42.1)	0.79 (0.55–1.13)	0.199
Nurse	64 (19.6)	65 (9.2)	**1.65 (1.21–2.23)**	**0.001**
Resident	19 (5.8)	62 (8.8)	0.80 (0.45–1.43)	0.450
Prior CPR course	250 (76.5)	373 (55.5)	**1.84 (1.15–2.93)**	**0.011**
How many years ago[a]	1 (0–16)	4 (0–24)	0.95 (0.86–1.06)	0.344

rPR, raw prevalence ratio; 95% CI, 95% confidence interval; *p* values obtained using generalised linear models with *Poisson* family, log link function, robust models and respondent work site as cluster. The values highlighted in "bold" are the statistically significant and would then be considered for the multivariate analysis.

[a] Median and range.
[b] It was categorized as follows: medical-non-medical, internal-non-internal, nurse-non-nurse, resident-non-resident.
Source: Authors.

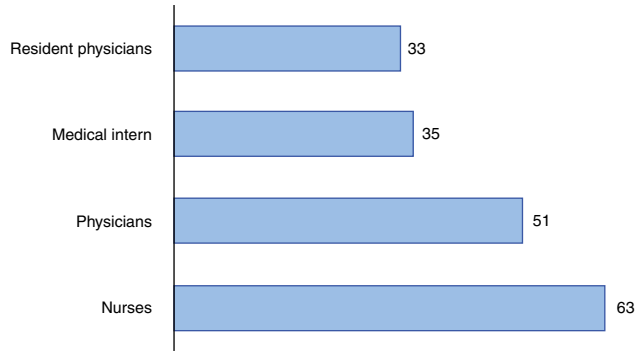

Fig. 2 – Good level of knowledge of cardiopulmonary resuscitation in 25 hospital sites in Peru.
***Source*: Authors.**

the quality of this intervention is instrumental for improving patient survival.[13,14]

Our study found that great deal of participants did not have good knowledge of CPR, consistent with findings of similar studies in Peru.[15–17] This may be due to very little training provided and the lack of regular training given to healthcare staff. Therefore, we recommend that hospital centres and other related institutions undertake their own situational analyses and assess level of knowledge, practices and other skills of their human resources when faced with SCA.

Our research found that the individuals with the best ratings in the CPR test were healthcare professionals who spent, in average, longer time in the emergency service. This is consistent with the report by Robak et al., which concluded that "learning through teaching" may improve self-confidence and provides in-depth knowledge by placing people in the situation of dealing with CPR on a regular basis, whenever it is required.[13,15–17] That explains why the respondents with better knowledge are those who spend more time in emergency settings, known to have a higher frequency of SCA cases.[18–20] Hence the suggestion of providing longer rotations in emergency services in medical schools and other institutions that provide training to future healthcare professionals, in order to create opportunities for teaching during situations of this kind.

Being a physician or a nurse resulted in higher average ratings in the CPR test. Studies regarding levels of knowledge of CPR among nursing professionals[21–24] reflect their regular training,[13,23] and the same has been found for medical practitioners,[17] whose ratings are higher after training. Other groups of professionals have lower response ratings, pointing to the fact that medical practitioners have more training and/or more exposure to medical emergencies.[8] This must be assessed in every hospital centre to determine if their healthcare staff are adequately trained and prepared for responding appropriately in those situations that require it.[9,25]

Moreover, it was found that the respondents with the lowest average ratings were those who were in their training stage, including interns and residents. Similar studies conducted in other countries[26–30] show that, despite participating in teaching programmes and practice, their knowledge is less than that of other professionals. This leads to the assumption that work and academic loads have a negative influence and result in knowledge decline given that it is not part of the routine medical work.[30,31] This calls for the provision of continuous training programmes throughout the education cycle so that staff in training can be prepared for dealing with these situations during training and beyond.

Respondents who had attended a prior course got better ratings in the CPR test. This is consistent with other similar publications[27] that measured CPR skills and knowledge and showed that levels of knowledge improved after attending the training (more than 20% improvement between pre- and post-test). However, retention levels had fallen by almost 10% 3 months after the intervention.[28] Likewise, a study conducted in Brazil suggested that the longer the time from completion of the undergraduate programme, the lower the level of theoretical knowledge of the compression/ventilation ratio and of the electric charge used for defibrillation, justifying the need for refresher courses in this area.[21,32] A local research study has shown that this is also true for company workers in whom knowledge improves with continuous training but stagnates or even declines over a certain period of time.[17] These findings show the importance of continuing education and the use of new teaching techniques, given the ever changing nature of emergency management which require awareness by the professionals of the need for constant updating. On the other hand, institutions must provide their healthcare workers with the adequate tools to ensure that they can perform CPR correctly.

A limitation of this study was selection bias because random sampling was not possible; however, the research did not intend to provide prevalences or frequencies for each site but rather to find associations with a good level of knowledge of CPR. Despite this limitation, results are important because they provide a window into the knowledge of the healthcare staff in multiple health institutions in our country, as part of this first multi-centre assessment, which may serve as a basis for further studies on this subject.

Results allow to conclude that the level of knowledge of CPR in 25 Peruvian hospitals was poor, and that individuals

Table 3 – Multivariate analysis of successful CPR test according to social and education variables of the healthcare staff in 25 hospital sites in Peru.

Variable	aPR (95% CI)	*p* value
Hours in emergency service	1.003 (1.002–1.0004)	<0.001
Profession/occupation[a]		
Physician	1.51 (1.13–2.03)	0.006
Nurse	1.45 (1.10–1.93)	0.009
Prior CPR course	1.20 (0.81–1.78)	0.359

aPR, adjusted prevalence ratio; 95% CI, 95% confidence interval; *p* value obtained using generalised linear models, with *Poisson* family, log link function, robust models, and respondent work site as cluster.

[a] It was performed with medical-non-medical, internal-non-internal, nurse-non-nurse, resident-non-resident categorization; Including the variables with emergency hours and previous course of rcp.

Source: Authors.

exposed to longer hours in the emergency service and with prior CPR courses, as well as two groups of professionals, had better ratings.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Appendix A. Cardiopulmonary resuscitation (CPR) knowledge test

Use an "X" for questions that require a mark. MARK ONLY ONE ANSWER FOR EACH QUESTION. IF YOU DO NOT KNOW THE ANSWER, LEAVE THE QUESTION BLANK

1. **What is the first step in case you find a person unconscious on the floor?**
   a) Check foot pulse
   b) *Call the local emergency system (LES)*
   c) Secure the area
   d) Give two rescue ventilations
   e) Wait for help
2. **Which would be the next step after having activates the LES?**
   a) Secure de rescue area
   b) See, listen and feel
   c) *Chest compressions*
   d) Give two ventilatos
   e) Check the airway
3. **The current algorithm recommended by AHA (American Heart Association) is:**
   a) A-B-C
   b) B-A-C
   c) C-A-B
   d) C-B-A
   e) R-C-P
4. **Changes to the AHA algorithm are based on:**
   a) Evidence showing that ventilations are not necessary
   b) A shorter algorithm to ensure better understanding by 'lay' personnel
   c) *Variations in survival/mortality*
   d) Shorter time for initiating chest compressions
   e) Giving good ventilations
5. **What is the optimal depth (cm) to which an adult chest should be compressed?**
   a) From 3 to 5 cm.
   b) 6 cm.
   c) 5 *cm.*
   d) 4 cm.
   e) More than 8 cm.
6. **What is the minimum number of compressions that need to be given in 1 minute of CPR (cardiopulmonary resuscitation)?**
   a) 100
   b) 90
   c) 80
   d) 86
   e) 120
7. **The AED (Automatic External Defibrillator) could be used by:**
   a) Trained physicians
   b) *Any person*
   c) Any healthcare staff
   d) AHA Instructors
   e) Firefighters
8. **Chest compressions must be given considering which reference measurement:**
   a) *Middle of the sternum away from the xiphoid process*
   b) Inter-mammary line
   c) Middle of the patient's abdomen
   d) Under the patient's inter-mammary line
   e) In the middle of the chest, over the xiphoid process
9. **If you were responding to cardiopulmonary arrest with another rescuer, how often would you exchange roles (who gives compressions/ventilations and vice versa)?**
   a) 1 minute
   b) *Until de rescuer giving compressions gets tired*
   c) 2 minutes
   d) 5 minutes
   e) Until another rescuer arrives
10. **In case the patient reacts (regains consciousness), you must:**
    a) *Place him/her in recovery position looking towards the rescuer*
    b) Leave him/her in supine position until help arrives
    c) Place him/her in foetal position
    d) Elevate the legs in order to improve systemic circulation
    e) Place him/her in sitting position and allow him/her to breathe
11. **Once the AED arrives at the scene of the SCA, you should:**
    a) Give at least 2 minutes of CPR and then defibrillate
    b) *Defibrillate as soon as possible if the AED indicates it*
    c) Give 1 minute of CPR and then defibrillate
    d) Wait until trained staff arrives before using the AED.
    e) Determine if the patient is breathing
12. **The new AHA algorithm follows these parameters:**
    a) *Compression - Airway - Ventilation*
    b) Airway - Ventilation - Compression
    c) Compression - Defibrillation - Airway
    d) Ventilation - Compression - Airway
    e) Only ventilate if necessary
13. **When there is delay in starting CPR, what is the rate of patient survival reduction per minute?**
    a) 6%
    b) *10%*
    c) 5%
    d) 15%
    e) 3%
14. **The AED recognises only:**
    a) Atrial fibrillation
    b) *Ventricular fibrillation*

c) PSVT
d) Sinus tachycardia
e) Atrial flutter

15. **The new AHA guidelines emphasise:**
    a) *Chest compressions and early defibrillation*
    b) Ventilation and early defibrillation
    c) Airway and early defibrillation
    d) Compressions and early ventilation
    e) Calling for help quickly
16. **While the AED is analysing cardiac rhythm, you should**
    a) Remain at least 10 m away from the patient
    b) Keep your hands over the patches for improved AED analysis
    c) *Not touch the patient and put your hands in the air*
    d) Keep the patient's hands in an anatomic position
    e) Continue with the compressions
17. **After giving an AED discharge you should:**
    a) Wait 5 seconds because the electric shock might affect you if you touch the patient
    b) Start with chest compressions right away
    c) *Wait until the AED again analyses heart rhythm*
    d) Check the patient's pulse
    e) Shake the patient to see if there is any reaction
18. **The new link in the AHA survival chain includes:**
    a) Initiation of advanced life support
    b) *Intensive Care Unit*
    c) Initiating CPR with the AED
    d) Initiating management with AED and CPR
    e) Calling the firefighters
19. **The correct position of the arms of the person giving resuscitation is:**
    a) *Hands, elbows and shoulders straight and aligned*
    b) No hands, elbows or shoulders forming a straight line
    c) Straight elbows but not hands or shoulders
    d) None of the above
    e) Any, as long as compressions are given
20. **For how long should CPR be given to a person with SCA?**
    a) 20 minutes
    b) 5 minutes
    c) 10 minutes
    d) N.A. *(it depends on the victim and the person giving resuscitation)*
    e) Only 20 minutes

Source: Adapted from Ref. 10

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