Cardiopulmonary Arrest and Resuscitation—Emergency Nurses' Knowledge in Croatia

Sandro VIDMANIĆ, BSN, MSN,[a] Biljana KURTOVIĆ, MSN, PhD,[b] and Adriano FRIGANOVIC, BSN, MSN[c]

Background: *Healthcare workers' education is one of the most important factors in quality improvement and efficiency of caring for patients with cardiopulmonary arrest. Nurses with high-quality training are important members of the resuscitation team and have great influence on the quality of the resuscitation process and outcome.* ***Aim:*** *To determine the level of knowledge of cardiopulmonary resuscitation of nurses in emergency medicine centers by level of education; and to determine the relationship between knowledge level and additional training and work experience.* ***Material and Methods:*** *A cross-sectional descriptive multicenter study was conducted. The participants were nurses from Emergency Departments in three University Hospitals in Croatia. Overall, the sample was comprised of 91 emergency room nurses. Data were collected by a questionnaire specifically prepared for this study.* ***Results:*** *Knowledge of nurses in emergency room was not adequate in general. There was no relationship between the level of knowledge of cardiopulmonary resuscitation and nurses' educational level, but there was a statistically significant positive relationship between knowledge level and additional training ($p = .028$) and work experience ($p = .038$).* ***Conclusion:*** *The results of this study show the need for re-evaluation of the educational curricula for nurses in emergency medicine, aimed at standardizing formal educational models. Remodeling of nurse education is the key issue in ensuring good quality education and clinical skills for nurses in the field of emergency medicine and safe nursing care.*

Keywords: cardiopulmonary resuscitation, emergency medicine, nurses, theoretical knowledge

INTRODUCTION

Early recognition and application of cardiopulmonary resuscitation (CPR) interventions in cardiac arrest saves lives (Kaihula et al., 2018). Healthcare professionals need to know how to perform CPR as they face emergencies in which patients' lives are endangered (Pepera et al., 2019). The science of resuscitation is constantly advancing, and clinical guidelines are updated regularly to provide healthcare professionals with evidence-based practice recommendations (Hunyadi-Antičević, 2011). Early recognition and effective therapeutic procedures for patients whose condition is deteriorating can prevent the development of cardiopulmonary arrest (Hunyadi-Antičević et al., 2013; Lott et al., 2015). CPR aims to preserve life, reduce suffering, and prevent disability. Since the nurse is the first contact with the patient, nurses' knowledge of CPR is crucial in responding appropriately and independently carrying out CPR procedure. Despite the importance of nurses in CPR, there is a dearth of

[a]*Department of Anaesthesiology and Intensive Medicine, University Hospital Centre Rijeka, Rijeka, Croatia*

[b]*Lecturer, Department of Nursing, University of Applied Health Sciences, Mlinarska 38, Zagreb, Croatia 10000. E-mail: Biljana.Kurtovic@zvu.hr*

[c]*Head Nurse, Department of Anaesthesiology and Intensive Medicine, University Hospital Centre Zagreb, Kispaticeva 12, Zagreb, Croatia*

http://dx.doi.org/10.1891/WFCCN-D-20-00019

evidence on their CPR knowledge and skills. This study attempts to address this gap, by employing a survey of emergency nurses in Croatia to investigate their knowledge of early warning signs and management of cardiac arrest.

When cardiopulmonary arrest occurs in monitored patients in hospital, it is usually noticed very quickly. Recognizing cardiopulmonary arrest, calling for help, and initiating resuscitation should be a basic skill of all healthcare professionals. For example, when defibrillation is delayed, efficiency is reduced by almost 10% per minute (Goyal et al., 2020). There is sufficient scientific evidence to show that the main predictors of survival are the time of the onset of resuscitation, the effectiveness of the basic resuscitation procedures, and the timing of early defibrillation (Čanađija, 2014). These predictors can also be presented as a "survival chain" which represents a set of interventions consisting of four "links" which contribute to a successful outcome after cardiac arrest: early recognition and calling for help, CPR, early defibrillation, and postresuscitation care (Hunyadi-Antičević et al., 2013; Lott et al., 2015; Søreide et al., 2013). It is necessary to ensure quality external heart massage by pressing 5 cm in depth, at a frequency of 100–120 compressions per minute, and allowing the chest to fully return to the initial position. Interruptions to heart massage to perform other procedures should be reduced to a minimum—this means that any interruption to heart massage should be planned in advance (Hunyadi-Antičević et al., 2013; Panchal et al., 2020). The return of spontaneous circulation (ROSC) is an important stage in resuscitation; however, the ultimate goal is that the patient achieves normal brain function, heart rate and stable hemodynamic parameters with minimal risk of further cardiopulmonary arrest. The quality of treatment in the postresuscitation period affects the patient's final outcome (Yannopoulos et al., 2015). Precisely because of aforementioned, the importance of ACLS and basic life support (BLS) credentialing for nurses comes to the fore.

Knowledge of BLS procedures is one of the basic skills that every healthcare professional should know (Legčević et al., 2019). Successful treatment of cardiac arrest taking place in a hospital setting requires staff training, monitoring, and recognition of the deterioration in the patient's condition, a system of calling for help, and an effective response (Hunyadi-Antičević et al., 2013; Smith, 2010). The Early Warning Score (EWS) is based on the usual vital signs, which are scored depending on how much they deviate from arbitrarily, agreed "normal" values (Prytherch et al., 2010). A significant increase in the number of points of one or more vital signs indicates the degree of intervention the patient requires; an increased score indicates an increased risk of deterioration and death (Hunyadi-Antičević et al., 2013). Understanding the significance of early warning signs such as shock, neurological signs, malaise, and acute coronary syndrome (Souza et al., 2019) is of utmost importance for helping nurses to prevent cardiac arrest. The basic goal of the ABCDE approach for patient assessment and treatment is to first identify and stabilize the patient's most serious problems, before moving on to the next vital system to achieve clinical improvement and to gain time for further treatment and diagnosis (Soltan & Kim, 2016).

The nurse, as part of the team providing advanced life support (ALS) measures, must have a broad range of knowledge and skills, and must be able to provide high-quality postresuscitation care before the patient is placed in an intensive care unit. The incidence of cardiac arrest in hospital ranges from 1 to 5 per 1,000 patients, and the survival rate after cardiopulmonary arrest is up to 13.5% only (Hunyadi-Antičević et al., 2013). Some studies have shown that the survival rate may double or triple if CPR is appropriately and correctly performed (de Almeida et al., 2011).

In the Republic of Croatia, for now, there is no data base of resuscitation or any other form of systematic monitoring of resuscitation outcomes, for either outpatients or inpatients, which should

certainly be changed in the near future. Since there used to be no official specialization for emergency nurses, this article will add significant data for the improvement of clinical practice in Croatia. As nurses knowledge and competency level are important in recognizing and preventing cardiac arrest and improving in survival outcomes, changes in nursing curriculums and mandatory educational programs could improve survival outcomes.

AIMS AND OBJECTIVES

The overarching aim of this study was to explore and compare the levels of nurses' knowledge of cardiopulmonary arrest and resuscitation in hospital conditions with regard to education background, additional education, and different hospital. The specific aims of the study were to (a) determine knowledge of cardiopulmonary arrest and resuscitation of nurses employed in emergency departments; (b) determine the association between education level and knowledge of cardiopulmonary arrest and resuscitation in a hospital setting; (c) examine the impact of additional education as part of continuing professional development in the field of emergency medicine and resuscitation on the knowledge level of cardiopulmonary arrest and resuscitation in hospital settings; and (d) determine the association between work experience and level of knowledge of cardiopulmonary arrest and resuscitation in a hospital setting.

METHOD

Study Design

An exploratory correlational cross-sectional multicenter study was conducted.

Participants, Setting, and Sample

The target population was full-time nurses employed in Emergency Rooms in three randomly selected University Hospitals in Croatia. We employed a convenience sample. Participants were registered nurses, and registerednurses with a Bachelor's degree, or a Masters' degree. Inclusion criteria were nurses who work in emergency unit, exclusion criteria were nurses with work experience less than 6 months. The study was conducted from December 2015 to April 2016.

Instruments

The questionnaire was developed by the authors and consists of two parts: demographic characteristics (i.e., institution, gender, age, degree, additional resuscitation training, work experience), and an evaluation of theoretical knowledge, through 60 true/false questions with 50% chance of correct answers, developed by the authors. The first group of questions (1–20) covers the area of ABCDE patient access, vital signs, and simple airway opening procedures; the second group (21–40) encompasses the area of CPR; and the third group (41–60) covers heart rhythms, administration of drugs during resuscitation, reversible causes of cardiopulmonary arrest, and safe defibrillation. The questionnaire was distributed to hospitals by main researchers in coordination with the head nurses by paper form.

Statistical Analysis

The data were analyzed by descriptive methods, and the distribution of quantitative variables were tested for normality by the Kolmogorov–Smirnov test. Due to the fact that the data were not normally distributed, nonparametric tests were used to explore comparisons and differences. The Mann–Whitney U test was used to compare test scores between different variables, such as level of education, additional education, and work experience. The correlation between test scores and additional training was examined by a Spearman coefficient rank correlation (rho). To investigate the differences between groups of responders based on length of service, the nonparametric, Kruskal–Wallis test, was used, and to determine which groups had a difference between them a post-hoc test was used. The significance level was set as alpha = .05.

Ethical Principles

The nurses signed a written informed consent to participate in the study, and the research was approved by the Ethical Committee of each hospital. The nurses were approached by a member of the research team. The answers on the questionnaire were anonymous: respondents in completing the questionnaire were not asked for personal information that could be used to identify them later. Participation was voluntary.

RESULTS

Characteristics of Participants

The demographic characteristics of participants are presented in Table 1. Researchers invited 143 nurses from three hospitals, 91 responded positively and completed the questionnaire. Of the total number of participants (91), 54 (59.3%) were women and 37 (40.7%) men. In Hospital A, of a total of 32 participants, 15 (46.9%) were women and 17 (53.1%) were men; in Hospital B, of a total of 30 respondents, 22 (73.3%) were women and 8 (26.7%) were men; and in Hospital C, of a total of 29 respondents, 17 (58.6%) were women, and 12 (41.4%) were men.

With regard to educational background, registered nurses predominated (secondary level of education), (n = 60, 65.9%), while there were 31 (34.1%) nurses with a Bachelor's and a Masters' degree.

The analysis of the age groups showed a roughly equal distribution of respondents by age: in the age group 18–30 years there were 35 (38.4%) respondents (9 [25.7%] women and 26 [74.3%] men); in the age group 31–40 years there were 29 (31.9%) respondents (22 [75.9%] women and 7 [24.1%] men) and in the age group >40 there were 27 (29.7%) respondents (23 [85.2%] women and 4 [14.8%] men).

According to the analysis of the work experience of respondents, 17 (18.7%) had ≤5 years work experience, 36 (39.6%) had 6–15 years of work experience, 18 (19.8%) had 16–24 years of work experience, and 20 (21.9%) respondents had ≥25 years of work experience. More results are presented in Table 1.

Of the 32 participants from Hospital A, 70.9% answered correctly and 29.1% incorrectly; of the 30 respondents from Hospital B, 75.2% answered correctly and 24.8% incorrectly; and of the 29 participants at Hospital C, 81% answered correctly and 19.0% incorrectly. Detailed results are presented in Table 2.

The results showed that there was no association between knowledge levels and educational degree p = .906 (Figure 1). The study results also showed significant differences in the level of knowledge and participation in additional training (p = .028) and work experience (p = .038).

DISCUSSION

The aim of this descriptive cross-sectional multicenter study was to determine the levels of knowledge of CPR nurses in emergency departments and its association with background characteristics, that is, level of education, work experience, and additional training. Knowledge and skills of CPR are basic requirements for healthcare professionals—every doctor and nurse should be able to recognize cardiopulmonary arrest and take appropriate action, using procedures based on current professional standards. Our results show inadequate knowledge of cardiopulmonary arrest and resuscitation in a significant proportion of emergency nurses in Croatia.

Only a small number of authors so far have investigated the theoretical knowledge of nurses employed in emergency medicine. Although the importance of training health professionals in CPR is recognized, research conducted worldwide indicates several problems (Carlo et al., 2009; de Almeida et al., 2011).

The results of our study support the need for nurses in emergency departments to attend ALS courses, as well as continuing knowledge renewal courses, which is concordant with other findings

TABLE 1. Demographic Characteristics of Emergency Nurses Who Participated in the Study (*N* = 91)

	Hospital A		Hospital B		Hospital C	
	n	**%**	***n***	**%**	***n***	**%**
Gender						
Female	15	46.9	22	73.3	17	58.6
Male	17	53.1	8	26.7	12	41.4
Education						
Vocational	18	56.2	15	50.0	27	93.1
Bachelor's/Masters' degree	14	43.8	15	50.0	2	6.9
Age in years						
18–30	21	65.6	5	16.7	9	31.0
31–40	9	28.1	8	26.7	12	41.4
>40	2	6.3	17	56.6	8	27.6
Work experience in years						
≤5	10	31.3	5	16.7	3	10.3
6–15	14	43.7	5	16.7	16	55.2
16–24	6	18.8	9	30.0	3	10.3
≥25	2	6.2	11	36.6	7	24.2
Additional training						
With training	19	59.4	26	86.7	9	31.0
Without training	13	40.6	4	13.3	20	69.0

TABLE 2. Comparison of the Test Results in the Three Different Hospitals

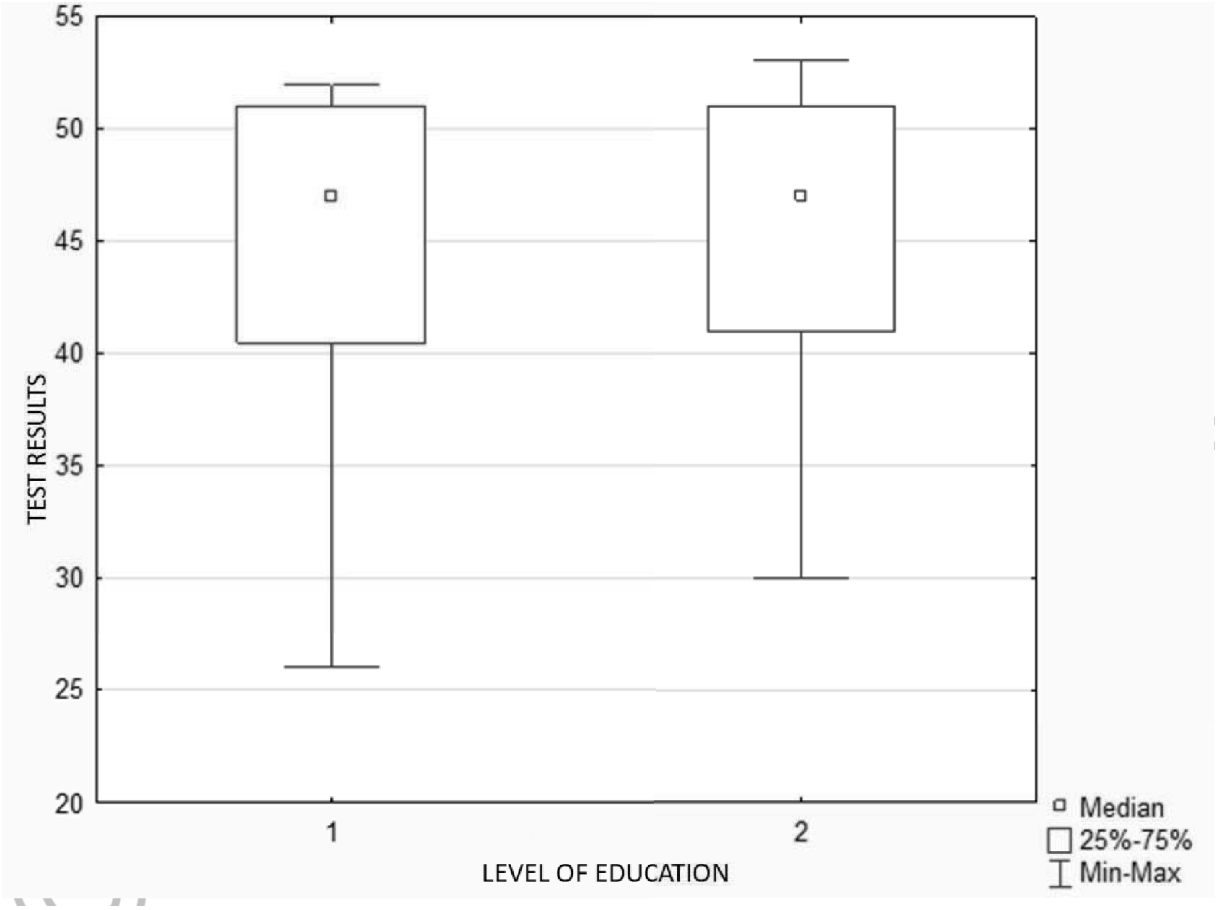
	First group of questions[a]		Second group of questions[b]		Third group of questions[c]	
	Correct *n*(%)	**Incorrect *n*(%)**	**Correct *n*(%)**	**Incorrect *n*(%)**	**Correct *n*(%)**	**Incorrect *n*(%)**
Hospital A	485 (76.0)	155 (24.0)	446 (70.0)	194 (30.0)	430 (67.0)	210 (33.0)
Hospital B	461 (77.0)	139 (23.0)	460 (77.0)	140 (23.0)	433 (72.0)	167 (28.0)
Hospital C	466 (80.0)	114 (20.0)	470 (81.0)	110 (19.0)	473 (82.0)	107 (18.0)

[a]First group of questions = ABCDE approach, vital signs assessment, airway management. [b]Second group of questions = CPR procedure. [c]Third group of questions = heart rhythms assessment, drugs administration, defibrillation.

(Hunyadi-Antičević, 2011). For example, in many hospitals worldwide, staff need to be certified for BLS every 2 years (Smith et al., 2008).

Nurses are often the first health professionals to identify a patient with cardiopulmonary arrest in a hospital setting (Rajeswaran et al., 2018). Numerous studies have shown significant progress in knowledge, skills, and efficiency after attending training (Carlo et al., 2009). Research conducted by Hulme et al. showed no difference between physicians and nurses after completing an ALS course in skills resuscitation, either as a member or a team leader (Hulme et al., 2003).

Figure 1. Emergency nurses' cardiopulmonary arrest and resuscitation knowledge by level of education[a] (*N* = 91).



[a]Level 1 of education = registered nurses. Level 2 of education = registered nurses with a Bachelor's degree, or a Masters' degree

According to the results of our study, there is no statistically significant difference in the level of knowledge between nurses with different levels of education. These results raise a question about the curricula of nurse education in CPR at all levels.

The hypothesis that there would be a statistically significant difference in the level of knowledge of cardiopulmonary arrest and resuscitation in hospital conditions according to nurses' education level was not supported by our findings. Conversely, the hypothesis that there would be a positive correlation between additional education in the field of emergency medicine and resuscitation and the level of knowledge of cardiopulmonary arrest and resuscitation in hospital conditions was supported. Those who had undergone additional resuscitation training exhibited greater level of knowledge. According to Bukiran et al. (2014), after even one day of training nurses' knowledge of resuscitation was increased in the short term and at 6 and 12 months after training, relative to the initial level of knowledge. However, the level of knowledge of the participants in their study began to decline early, mainly after the 6 month.

Based on these results and those of our study, it would be useful to offer all employees periodic training, especially for nurses who work in places with fewer everyday procedures involving resuscitation. The results of our study confirm the importance and effectiveness of additional

education in the field of emergency medicine and resuscitation, and further emphasize the need for a defined and standardized education.

LIMITATIONS

A limitation of this study was the use of a nonvalidated questionnaire developed by the authors. The questionnaire was developed in accordance with guidelines of the European Resuscitation Council and it was supported by the Croatian Nurses Society of Anesthesia, Reanimation, Intensive Care and Transfusion. However, the questionnaire was not validated, and we were not able to perform factor analysis. Moreover, aspect of reliability was not investigated.

CONCLUSION

Our findings showed that the level of education in Croatia does not have significant influence on levels of knowledge of resuscitation. The results indicate the need to evaluate the curricula of education of nurses in the field of emergency medicine and resuscitation with the aim of standardizing formal education. It is necessary to structure an educational model that will provide nurses with comprehensive theoretical and practical teaching in order to raise the quality of nursing care and their knowledge of emergency medicine to an even higher level.

REFERENCES

Bukiran, A., Erdur, B., Ozen, M., & Bozkurt, A. I. (2014). Retention of nurses' knowledge after basic life support and advanced cardiac life support training at immediate, 6-month, and 12-month post-training intervals: A longitudinal study of nurses in Turkey. *Journal of Emergency Nursing*, *40*(2), 146–152.

Čanađija, M. (2014). *Retrospektivna analiza usvojenog teorijskog znanja medicinskih sestara/tehničara na tečajevima neposrednog održavanja života*, Master thesis, Zagreb: Sveučilište u Zagrebu, Medicinski fakultet. (In Croatian)

Carlo, W. A., Wright, L. L., Chomba, E., McClure, E. M., Carlo, M. E., Bann, C. M., Collins, M., & Harris, H. (2009). Educational impact of neonatal resuscitation program in low-risk delivery centres in a developing country. *The Journal of Pediatrics*, *154*(4), 504–508. https://doi.org/10.1016/j.jpeds.2008.10.005

de Almeida, A. O., Araújo, I. E., Dalri, M. C., & Araujo, S. (2011). Theoretical knowledge of nurses working in nonhospital urgent and emergency care units concerning cardiopulmonary arrest and resuscitation. *Revista Latino-Americana de Enfermagem*, *19*(2), 261–268.

Goyal, A., Chhabra, L., & Sciammarella, J. C. (2020, August 15). Defibrillation. In *StatPearls [Internet]*. StatPearls. Publishing2020 .https://www.ncbi.nlm.nih.gov/books/NBK499899/

Hulme, J., Perkins, G. D., Baldock, C., & MacNamara, A. (2003). Use of advanced life support skills. *Resuscitation*, *58*(1), 59–63.

Hunyadi-Antičević, S. (2011). *Analiza čimbenika koji utječu na osposobljenost polaznika organiziranog programa trajnog usavršavanja iz područja reanimacije*. doctoral dissertation, Zagreb: Sveučilište u Zagrebu, Medicinski fakultet. In Croatian

Hunyadi-Antičević, S., & Lojna Funtak, I. (2013). Na*predno održavanje života: smjernice Europskog vijeća za reanimatologiju 2010. godine*. Medicinska naklada. In Croatian

Kaihula, W. T., Sawe, H. R., Runyon, M. S., & Murray, B. L. (2018). Assessment of cardiopulmonary resuscitation knowledge and skills among healthcare providers at an urban tertiary referral hospital in Tanzania. *BMC Health Services Research*, *4*(18), 935.

Legčević, M., Režić, S., & Friganović, A. (2019). Osvrt na smjernice temeljnih postupaka oživljavanja/ A review of guidelines for basic life support. *Sestrinski glasnik*, *24*(2), 94–98. (In Croatian)

Lott, C., Abbas Khalifa, G., Ballance, Domanovits, H., Lockey, A., Perkins, G., & et al. (2015). *Advanced life support course manual: ERC guidelines 2015 edition*. European Resuscitation Council.

Panchal, A. R., Bartos, J. A., Cabañas, J. G., Donnino, M. W., Drennan, I. R., & Hirsch, K.

G. (2020). Part 3: Adult basic and advanced life support: 2020 American heart association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care & Adult Basic and Advanced Life Support Writing Group. *Circulation*, *142*(16_suppl_2), S366–S468.

Pepera, G., Xanthos, ·, Lilios, A., & Xanthos, T. (2019). Knowledge of cardiopulmonary resuscitation among Greek physiotherapists. *Monaldi Archives for Chest Disease*, *89*(3): 1-6.

Prytherch, D. R., Smith, G. B., Schmidt, P. E., & Featherstone, P. I. (2010). ViEWS –Towards a national early warning score for detecting adult in-patient deterioration. *Resuscitation*, *81*(8), 932–937.

Rajeswaran, L., Cox, M., Moeng, S., & Tsima, B. M. (2018). Assessment of nurses' cardiopulmonary resuscitation knowledge and skills within three district hospitals in Botswana. *African Journal of Primary Health Care & Family Medicine*, *10*(1), e1–e6.

Smith, G. B. (2010.). In-hospital cardiac arrest: Is it time for an in-hospital "chain of prevention"? *Resuscitation*, *81*(9), 1209–1211.

Smith, K. K., Gilcreast, D., & Pierce, K. (2008). Evaluation of staff's retention of ACLS and BLS skills. *Resuscitation*, *78*(1), 59–65.

Soltan, M., & Kim, M. (2016). The ABCDE approach explained. *The BMJ*, *355*, i4512.

Søreide, E., Morrison, L., Hillman, K., Monsieurs, K., Sunde, K., Zideman, D., Eisenberg, M., Sterz, F., Nadkarni, V. M., Soar, J., & Nolan, J. B. (2013). The formula for survival in resuscitation. *Resuscitation*, *84*(11), 1487–1493. https://doi.org/10.1016/j.resuscitation.2013.07.020

Souza, B., Lopes, M. C., Okuno, M. F., Batista, R. E., Góis, A. F., & deCampanharo, C. R. (2019). Identification of warning signs for prevention of in-hospital cardiorespiratory arrest. *Revista Latino-Americana de Enfermagem*, *27*, e3072.

Yannopoulos, D., Aufderheide, T. P., Abella, B. S., Duval, S., Frascone, R. J., Goodloe, J. M., Mahoney, B. D., Nadkarni, V. M., Halperin, H. R., O'Connor, R., Idris, A. H., Becker, L. B., & Pepe, P. E. (2015). Quality of CPR: An important effect modifier in cardiac arrest clinical outcomes and intervention effectiveness trials. *Resuscitation*, *94*, 106–113.

Disclosure. The authors have no relevant financial interest or affiliations with any commercial interests related to the subjects discussed within this article.

Acknowledgment. The Croatian Nurses Society of Anesthesia, Reanimation, Intensive Care and Transfusion supported the writing of this manuscript.

Funding. The author(s) received no specific grant or financial support for the research, authorship, and/or publication of this article.