Original/Research Paper

Effect of in-service training courses in neonatal cardiopulmonary resuscitation on the rate of successful resuscitation in nurses working in the neonatal department: A quasi-experimental study

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Abstract

The present study aims to determine the effect of in-service training courses in neonatal cardiopulmonary resuscitation (CPR) on the rate of successful resuscitation in nurses working in the neonatal department. This quasi-experimental study was conducted among nurses employed in the neonatal department at the Sayad Shirazi Hospital in Gorgan, Golestan province, Iran. The in-service training course for neonatal CPR was conducted in two separate groups across consecutive days, following the latest Heart Association guidelines. Subsequently, an evaluation was conducted across four levels: knowledge, learning, behavior, and performance. After calculating the coefficients for each level, the resulting figures were compared with the successful rehabilitation index. A total of 30 nurses were participants in the research. In the initial level, nurses' satisfaction with the course conditions significantly increased from 56.26 to 93.76 out of 100 points post-intervention (P<0.01) as per the paired t-test. Moving to the second level, there was a substantial improvement in learning scores, rising from 13.12 (SD=2.82) before the intervention to 16.32 (SD=2.21) after (P<0.01). At the third level, behavior scores increased from 32.19 to 47.80 after accounting for a factor of 3, showing significant improvement (P<0.01). For the fourth level, the successful resuscitation rate increased from 50% to a calculated score of 200.2 after applying a coefficient of 4 (P<0.01). Combining these levels and considering coefficients, the overall effectiveness of the course was calculated at 69.86%. In sum, the study revealed suboptimal effectiveness in the newborn CPR training course. Consequently, nursing education system managers and practitioners should delve into the impediments and factors influencing this course.

Keywords: Nurses, Nursing, Effectiveness, In-service Training, Cardiopulmonary Resuscitation, Infants.

1 │ Introduction

The occurrence of cardiac arrest in infants and children in the United States surpasses 15,000 instances annually. Roughly one in ten newborns necessitates cardiopulmonary resuscitation (CPR) [1]. As per the World Health Organization report, around 3-6% of newborns require CPR [2], which significantly reduces infant mortality by 99% [3]. A study conducted in India suggests that implementing proper resuscitation practices in infants could prevent approximately 6,000 deaths annually among babies and infants [4]. In comparison to adults, infants generally have a higher chance of survival through CPR [1]. Effective resuscitation within the critical time frame, often referred to as the "golden interval", hinges upon possessing adequate knowledge and skills [5, 6]. Utilizing guidelines for newborn CPR significantly enhances the competency of medical staff [7, 8]. The American Heart Association updated the CPR guidelines in 2020 [9], emphasizing the pivotal role of comprehensive training for rehabilitation teams in improving procedural quality [10].

The transfer of neonatal resuscitation knowledge significantly contributes to enhancing the competencies of neonatal ward nurses [11]. In-service training courses, specifically focused on CPR skills, play a critical role in improving healthcare professionals' abilities [12]. Such training initiatives aim to elevate knowledge, technical expertise, and job-related skills, priming employees for their responsibilities [13]. Among these courses, CPR training for nurses stands out as one of the most crucial skill-building programs [14].

However, studies highlight a low success rate in CPR [15], often attributed to deficiencies in knowledge, attitude, and skills, contributing to unsuccessful outcomes [16]. Hence, comprehensive training programs are paramount in enhancing the quality of CPR procedures [17]. Additionally, evaluation is recognized as a cornerstone of education, providing crucial insights for system design and refinement [18]. Educational evaluations furnish valuable information vital for the development and adjustment of organizational systems [14]. Assessing training effectiveness involves gauging the extent to which training programs have instilled practical skills required by the organization [13]. Ultimately, effectiveness is achieved when it translates into improved performance in the workplace and the application of learning in real-world settings [14].

There are various models used to assess the effectiveness of training courses, and among them, Kirkpatrick's evaluation model stands out as one of the most significant [19, 20]. This model evaluates in-service training across four levels: reaction, learning, behavior, and results [19, 21, 22]. However, most educational programs tend to focus on the initial levels of this model, with fewer assessments conducted at the higher levels. Unfortunately, comprehensive evaluations are rare in educational settings [23].

The training provided for medical staff, especially nurses, in CPR is regarded as a fundamental professional skill [24]. The mastery of nurses and other healthcare workers in correctly applying CPR skills can significantly impact patient outcomes, potentially saving lives [14]. Kirkpatrick's model, known for its simplicity and practicality in evaluating clinical courses, plays a crucial role in enhancing the quality of education [22, 23]. It is widely recognized as one of the most common and important models for gauging educational effectiveness [20]. Given the vital role of the CPR course within nurses' in-service training programs, this study aims to assess the effectiveness of neonatal CPR training based on the Kirkpatrick model.

2 │ Methods

2.1 │ Study design

This quasi-experimental study was conducted among nurses employed in the neonatal department at the Sayad Shirazi Hospital in Gorgan, Golestan province, Iran.

2.2 │ Ethics consideration

The study obtained ethical approval from the Ethics Committee of Gorgan University of Medical Sciences, identified by the code IR.GOUMS.REC.1401.140. Before participation, all individuals involved provided informed consent after receiving a detailed explanation of the study's objectives. Participants were explicitly informed about their right to withdraw from the study at any stage if they chose to do so, ensuring their autonomy and voluntary participation**.**

2.3 │ Participants

The criteria for inclusion in this study encompassed nurses with bachelor's and master's degrees who are employed in the neonatal department of the hospital and were selected through a convenience sampling method.

2.4 │ Intervention

Upon elucidating the research's intent to hospital officials and participating nurses, a commitment to confidentiality was assured. The educational course content centered on the most current CPR guidelines, crafted and collated with the input and approval of 10 experts. The workshop spanned two consecutive days, running from 8 AM to 12 PM, and its efficacy was subsequently assessed using the Kirkpatrick model.

In the initial stage (reaction level) of assessment, a survey form was utilized to gauge participants' responses concerning various aspects, including class environment, teaching methodologies, content delivery, and educational resources. This form comprised 12 questions, with 4 addressing workshop content, 4 evaluating the instructor, and 4 focusing on course facilities. Responses were rated on a 5-point Likert scale ranging from 1 (very weak) to 5 (very strong). To standardize scores across the research, these were converted to a scale of 100, maintaining a coefficient of one for the obtained scores.

To assess the second level (learning), researchers administered a 20-question questionnaire aligned with the 2020 guidelines of the American Heart Association for basic and advanced infant CPR. Each question was scored from 0 to 20 points, with correct answers receiving a score of 1 and incorrect ones, a score of 0. A higher score indicated a greater grasp of neonatal CPR

concepts. Participants completed this questionnaire twice: first before the commencement of the in-service training course (at the beginning of the class) and then after the completion of the training course. Each questionnaire, comprising 20 questions, required approximately 10 minutes to complete before and after the training session.

In the third level of assessment, behavior, and performance were scrutinized. Two months post the in-service training, the researcher employed a checklist designed by Yeo and colleagues to appraise the performance of newborn CPR and behavior. This checklist involved evaluating CPR in both initial and advanced scenarios. Scores were allocated across three sections: initial assessment (7 questions, scoring from 0 to 11), ventilation (8 questions, scoring from 0 to 15), and cardiac massage (8 questions, scoring from 0 to 14), resulting in a potential skill assessment range of 0 to 40. A higher score denoted a higher skill level. Subsequently, the researcher assigned a factor of 3 to this level to standardize scores to reach a maximum of 100 for this assessment phase.

At the fourth level, the focus was on examining the outcomes concerning the educational objectives and the overall efficacy of the course. To gauge effectiveness, the researcher initially computed the success rate of resuscitation six months post the in-service training course and compared it to the rate six months before the training commenced. Upon obtaining these success rates, the researcher scaled the results to 100 and applied a coefficient of 4 to standardize this level of assessment.

To determine the overall effectiveness, the researcher computed coefficients from all four levels and derived an average out of 100. If this percentage falls below the unsuccessful resuscitation index or surpasses the successful resuscitation index, it confirms the effectiveness of the course. The calculation involves using a specified index according to Health Department guidelines. This index entails dividing the number of unsuccessful resuscita-

tions by the total resuscitations performed at that time, then multiplying the result by 100. Comparing the average percentage from the research with these indices helps establish the effectiveness of the course.

2.5 │ Statistical analysis

In the analysis phase, SPSS software (version 16.0, SPSS Inc., Chicago, IL, USA) was utilized to process the data. Descriptive statistics were employed, presenting means and standard deviations (SD) for continuous variables to offer a comprehensive overview of the dataset. The study employed an paired t-test as part of the analysis. A significance level of 0.05 was set as the threshold to ascertain statistical significance in the obtained results.

3 │ Results

3.1 │ Participants

The study encompassed a total of 30 nurses employed within the neonatal department who were participants in the research.

3.2 │ The effectiveness of the Kirkpatrick model in the in-service training course on neonatal CPR

In the initial level, nurses' satisfaction with the course conditions significantly increased from 56.26 to 93.76 out of 100 points post-intervention (P<0.01) as per the paired t-test. Moving to the second level, there was a substantial improvement in learning scores, rising from 13.12 (SD=2.82) before the intervention to 16.32 (SD=2.21) after (P<0.01). At the third level, behavior scores increased from 32.19 to 47.80 after accounting for a factor of 3, showing significant improvement (P<0.01). For the fourth level, the successful resuscitation rate increased from 50% to a calculated score of 200.2 after applying a coefficient of 4 (P<0.01). Combining these levels and considering coefficients, the overall effectiveness of the course was calculated at 69.86% (Table 1).

Table 1. The effectiveness of the Kirkpatrick model in the in-service training course of neonatal CPR.

	The score obtained	Score based on 100	The score including the coefficient
First level (reaction)	56.26	93.76	93.76
Second level (learning)	16.33	81.65	163.3
Third level (behavior)	32.19	80.47	241.42
Fourth level (results)	50.05	50.05	200.2
Total		69.86%	

4 │ Discussion

The study revealed that the course's effectiveness stood at 69.86%, falling short compared to typical CPR benchmarks. Additionally, the minimal disparity in successful resuscitation rates

pre- and post-training suggests the need for a thorough reevaluation of this course. Addressing its shortcomings is crucial, as the primary aim of applying the Kirkpatrick model to assess effec-

tiveness is to refine and adapt the educational process [25]. Enhancing the skills and knowledge imparted in cardiopulmonary courses significantly contributes to reducing patient mortality, particularly in infants [26]. Thus, healthcare system managers and practitioners must prioritize the reevaluation and enhancement of this training program, scrutinizing both its conditions and content [13]. Training and feedback during newborn CPR are pivotal in improving the performance of nurses in neonatal wards, concurrently addressing their weaknesses, thereby enhancing educational quality [4]. Simulator-based training for infant CPR, coupled with real-time assessment, markedly improves learning outcomes [4]. According to Kirkpatrick's effectiveness model, airway training significantly contributes to skill enhancement and learning [25].

Farhadi et al., (2023) demonstrated the effectiveness of nurses' competency in neonatal CPR through an in-service training course, assessed using the Kirkpatrick model. This evaluation method unveiled both the strengths and weaknesses of the training program [27]. Dorri et al., (2016) highlighted the comprehensive effectiveness of in-service training across all four levels of Kirkpatrick's model, showcasing the efficacy of CPR training [14]. Despite the course's effectiveness in the study by El Nsouli et al., (2023), enhancing the learning platform was suggested to elevate the quality of care [28]. A study by Huang et al., (2022) using the Kirkpatrick model revealed the effectiveness of innovative training for nurses across all four evaluation levels [29]. Lee & Song (2021) assessed a nursing education program based on the Kirkpatrick model, finding effectiveness in the initial two levels but lacking investigation into the latter two [20].

A study underscores how assessing the efficacy of training programs contributes to effective management, quality care provision, and the ongoing enhancement of the educational process [20]. Evaluating training program effectiveness significantly impacts the improvement and advancement of care systems [30]. Typically, the first two levels of evaluation focus on understanding and knowledge, while the latter two assess the efficacy and outcomes. Kirkpatrick's model for evaluating effectiveness adeptly gauges the level of learning and behavioral changes resulting from in-service training programs [13]. In-service training notably enhances the professional knowledge of human resources and facilitates the application of learning within the work environment. Kirkpatrick's educational effectiveness model stands as a standard and effective evaluation approach [31]. Essentially, evaluating educational effectiveness aids in determining the extent to which training has equipped individuals with the practical skills needed by the organization [32]. It serves as a crucial program within any organization, offering valuable insights for system design and refinement [13]. By employing this model for effectiveness evaluation, deficiencies within training programs can be identified and rectified [33].

4.1 │ Limitations

This study exhibits significant limitations. Firstly, its focus on a specific hospital restricts the applicability of its findings to a wider population, as variations in resources, practices, or patient demographics across different settings might yield different results. Secondly, the absence of a control group makes it difficult to attribute the observed enhancement in resuscitation rates solely to the training course. External influences or simultaneous protocol changes could also impact the outcomes. Additionally, potential biases in self-reported data or assessment methods might affect the reported success rates.

4.2 │ Recommendations for future research

Perform research studies that utilize control groups across diverse hospital settings to compare how effectively the training course influences outcomes, ensuring control over external influences. Broaden the research scope by engaging multiple hospitals or healthcare facilities, enabling a more comprehensive understanding that accommodates variations in resources and practices. Explore the incorporation of cutting-edge technologies, such as simulation or virtual reality, within training approaches, evaluating their impact on enhancing resuscitation outcomes.

5 │ Conclusions

In total, the study revealed suboptimal effectiveness in the newborn CPR training course. Consequently, nursing education system managers and practitioners should delve into the impediments and factors influencing this course. Addressing the limitations identified in this research is crucial for organizing a more impactful training program. Additionally, the study highlights Kirkpatrick's effectiveness model as a valuable framework for designing and strategizing training courses. Health authorities should prioritize assessing the efficacy of these training programs post-implementation.

Authors' contributions

Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work: SG, HH, NHP, MK, SF, MY; Drafting the work or revising it

critically for important intellectual content: SG, HH, NHP, MK, SF, MY; Final approval of the version to be published: SG, HH, NHP, MK, SF, MY; Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved: SG, HH, NHP, MK, SF, MY.

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Ethics approval and consent to participate
The study obtained ethical approval from the Ethics Committee of Gorgan University of Medical Sciences, identified by the code IR.GOUMS.REC.1401.140. Before participation, all individuals provided informed consent after receiving detailed information about the study's aims. Participants were explicitly in-formed of their right to withdraw from the study at any time if they chose to do so.

Competing interests
We do not have potential conflicts of interest with respect to the research, authorship, and publication of this article.

Availability of data and materials
The datasets used during the current study are available from the corresponding author on request.

Using artificial intelligent chatbots
None.

References

1. Parikh P, Samraj R, Ogbeifun H, Sumbel L, Brimager K, Alhendy M, et al. Simulation-Based Training in High-Quality Cardiopulmonary Resuscitation Among Neonatal Intensive Care Unit Providers. *Front Pediatr*. 2022;10:808992.

2. Kabusi M, Golfiroozi S, Rajabloo M, Yahyanezhad M, Hojjati H. The Effect Of Neonatal Cardiopulmonary Resuscitation Training On The Knowledge Of Neonatal Ward Nurses. *Int J Med Investig*. 2023;12(3):190-196.

3. Samieerad F, Talebi F, Mohitabadim Z, Barikani A. Comparison the Effect of two Educational Methods of Neonatal Resuscitation on The Knowledge and Practice of Clinical Staff Working in Kowsar Hospital in 2013. *Res Med Educ*. 2013;5(2):32-38.

4. Bishop R, Joy B, Moore-Clingenpeel M, Maa T. Automated Audiovisual Feedback in Cardiopulmonary Resuscitation Training: Improving Skills in Pediatric Intensive Care Nurses. *Crit Care Nurse*. 2018;38(5):59-66.

5. Sintayehu Y, Desalew A, Geda B, Shiferaw K, Tiruye G, Mulatu T, et al. Knowledge of Basic Neonatal Resuscitation and Associated Factors Among Midwives and Nurses in Public Health Institutions in Eastern Ethiopia. *Int J Gen Med*. 2020;13:225-233.

6. Zhu XY, Wu BQ. Recognition and discussion of several technical details in neonatal resuscitation training. *Zhongguo Dang Dai Er Ke Za Zhi*. 2020;22(6):555-560.

7. Singapore National Resuscitation Council's Neonatal And Paediatric Resuscitation Workgroup; Chong NK. Newborn and paediatric resuscitation 2011 guidelines. *Singapore Med J*. 2011;52(8):560-572.

8. Perkins GD, Graesner JT, Semeraro F, Olasveengen T, Soar J, Lott C, et al. European Resuscitation Council Guidelines 2021: Executive summary. *Resuscitation*. 2021;161:1-60.

9. Aziz K, Lee HC, Escobedo MB, Hoover AV, Kamath-Rayne BD, Kapadia VS, et al. Part 5: Neonatal Resuscitation: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2020;142(16_suppl_2):S524-S550.

10. Golfiroozi S, Sheikhnejad F, Kabusi M, esmaelpour H, Latifi N, Noei FR. The Effect of Training on Learning Cardiopulmonary Resuscitation Skills in Emergency Nurses. *Int J Med Investig*. 2022;11(4):122-128.

11. Eskandari Z, Akrami F. Neonatal resuscitation training for nurses: A literature review. *Iran J Cardiovasc Nurs*. 2019;8(1):190-196.

12. Araujo NR, Araújo RA, Moretti MA, Chagas ACP. Nursing training and retraining on cardiopulmonary resuscitation: a theoretical-practical intervention. *Rev Esc Enferm USP*. 2022;56:e20210521.

13. Hojjati H, Mehralizadeh Yl, Farhadirad H, Alostany S, Aghamolaei M. Assessing the effectiveness of training outcome based on Kirkpatrick model: case study. *Q J Nurs Manag*. 2013;2(3):35-42.

14. Dorri S, Akbari M, Dorri Sedeh M. Kirkpatrick evaluation model for in-service training on cardiopulmonary resuscitation. *Iran J Nurs Midwifery Res*. 2016;21(5):493-497.

15. Schluep M, van Limpt GJC, Stolker RJ, Hoeks SE, Endeman H. Cardiopulmonary resuscitation practices in the Netherlands: results from a nationwide survey. *BMC Health Serv Res*. 2019;19(1):333.

16. Majid A, Jamali M, Ashrafi MM, Ul Haq Z, Irfan R, Rehan A, et al. Knowledge and Attitude Towards Cardiopulmonary Resuscitation Among Doctors of a Tertiary Care Hospital in Karachi. *Cureus*. 2019;11(3):e4182.

17. Oermann MH, Krusmark MA, Kardong-Edgren S, Jastrzembski TS, Gluck KA. Training interval in cardiopulmonary resuscitation. *PLoS One*. 2020;15(1):e0226786.

18. Thrower EJB, Fay R, Cole L, Stone-Gale V, Mitchell A, Tenney E, et al. A Systematic Process for Evaluating Teaching Methods in Nursing Education. *Nurse Educ*. 2020;45(5):257-260.

19. Ahanchian M, Sharafi S, Vafaee M, Hajiabadi F. Evaluate the Effectiveness of internship program in nursing student using Kirkpatrick's model. *Res Med Educ*. 2017;9(1):17-19.

20. Lee H, Song Y. Kirkpatrick Model Evaluation of Accelerated Second-Degree Nursing Programs: A Scoping Review. *J Nurs Educ*. 2021;60(5):265-271.

21. Badran AS, Keraa K, Farghaly MM. Applying the Kirkpatrick model to evaluate dental students' experience of learning about antibiotics use and resistance. *Eur J Dent Educ*. 2022;26(4):756-766.

22. Johnston S, Coyer FM, Nash R. Kirkpatrick's Evaluation of Simulation and Debriefing in Health Care Education: A Systematic Review. *J Nurs Educ*. 2018;57(7):393-398.

23. Golfiroozi S, Hojjati H, Ranjbar Noei F, Kabusi M, Shikhnejad F, et al. The Effectiveness of In-service Training Course on Adult Cardiopulmonary Resuscitation Based on the Kirkpatrick Model. *J Health Rep Technol*. 2023;9(3):e137933.

24. Akbari M, Dorri S, Mahvar T. The effectiveness of in-service training on cardiopulmonary resuscitation: report of first and second levels of Kirkpatrick's model. *Dev Strateg Med Educ*. 2016;3(1):67-72.

25. Cheung VK, Chia NH, So SS, Ng GW, So EH. Expanding scope of Kirkpatrick model from training effectiveness review to evidence-informed prioritization management for cricothyroidotomy simulation. *Heliyon*. 2023;9(8):e18268.

26. Godarzi M, Sarhangy F, Mokhtari Nouri J, Seyed Amouzegar Zavareh SM. The Effectiveness of Neonatal Cardiopulmonary Resuscitation Training by Educare Method on Nurses and Midwives' Knowledge and Performance. *J Crit Care Nurs*. 2018;11(4):35-43.

27. Farhadi R, Azandehi BK, Amuei F, Ahmadi M, Zazoly AZ, Ghorbani AA. Enhancing residents' neonatal resuscitation competency through team-based simulation training: an intervention educational study. *BMC Med Educ*. 2023;23(1):743.

28. El Nsouli D, Nelson D, Nsouli L, Curtis F, Ahmed SI, McGonagle I, et al. The Application of Kirkpatrick's Evaluation Model in the Assessment of Interprofessional Simulation Activities Involving Pharmacy Students: A Systematic Review. *Am J Pharm Educ*. 2023;87(8):100003.

29. Huang X, Wang R, Chen J, Gao C, Wang B, Dong Y, et al. Kirkpatrick's evaluation of the effect of a nursing innovation team training for clinical nurses. *J Nurs Manag*. 2022;30(7):2165-2175.

30. Quinton ML, Tidmarsh G, Parry BJ, Cumming J. A Kirkpatrick Model Process Evaluation of Reactions and Learning from My Strengths Training for Life™. *Int J Environ Res Public Health*. 2022;19(18):11320.

31. Hatami H. An Evaluation of the Efficiency of the In-service Training Offered by the Human Resources Study Department in improving the performance of managers, faculty and staff of regional academic units of an Islamic Azad University. *J New Approaches Educ Adm*. 2010;1(3):77-100.

32. Rabiee F, Moayedi SN, Naderi Z, Aliabadi Farahani K, Shamsi M. Effect of in-service educational courses on human resources efficiency from university experts' point of view. *Educ Strateg Med Sci*. 2011;4(2):85-89.

33. van Tetering AAC, Ntuyo P, Martens RPJ, Winter N, Byamugisha J, Oei SG, et al. Simulation-Based Training in Emergency Obstetric Care in Sub-Saharan and Central Africa: A Scoping Review. *Ann Glob Health*. 2023;89(1):62.