Training for Nurses Using Realistic Simulation

ORIGINAL

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Abstract

Objectives: To assess an in situ simulation-based cardiopulmonary resuscitation training strategy, with emphasis on debriefing and follow-up assessment of knowledge after training.

Method: This was an educational intervention study to measure intraparticipant variability. The simulation-based teaching techniques consisted of nine steps. This research followed STROBE recommendations for the methodological development of observational studies, "See Supplementary File 1".

Results: Significant differences ($p < 0.05$) were observed between the pre-test and post-theory assessments, and between the pre-practical phase and 60 days post-training. However, no differences were observed ($p < 0.05$) between the post-theory and post-practical phases, showing that after participating in the training strategy, after the pre-test assessment, the participants seemed to have carried over the knowledge displayed in the post-theory to the post-practical time, with considerable reduction in performance 60 days after the training program.

Conclusion: Theoretical emphasis coupled with simulation practice displayed the best results in performance when compared to theoretical training alone, even at 60 days post-training.

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Keywords

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Introduction

Active teaching methods stand out in the educational field as tools to change the paradigm of health education. Such methods place students in immersive situations that simulate real-life problems, stimulating critical and reflective thinking skills before the need to come up with immediate solutions, helping construct knowledge [1].

Of the existing active learning strategies, simulations stand out as an innovative technique in health education. There is abundant evidence in the literature showing that this method improves learning, develops specific aptitudes, and contributes to integrating teams and developing ethical attitudes [2, 3].

Cardiopulmonary resuscitation (CPR) training programs enable and enhance professional decision-making and foster the development of technical care skills, considering that cardiorespiratory arrests represent a global public health issue. In the United States, the estimated prevalence is 209,000 cases per year, and in Brazil, 200,000, most of which occur in hospitals [4].

Therefore, nurses must develop advanced life support (ALS) skills, impacting patient survival, combining the team's comprehensive skills training and emergency care skills [5].

Nurses are health team leaders and must often handle emergency situations. Therefore, nursing training programs should prioritize quality of care and survival in this type of situation. Guidelines on CPR recommend standardizing actions and adopting unified language among health professionals for procedures to be carried out. Furthermore, simulation activities help improve and build skills. Simulation-based CPR training programs can help bring theoretical knowledge closer to practice and standardize CPR care. Considering the above, the aim of the present study was to evaluate an in situ simulation-based CPR training strategy, with emphasis on debriefing and follow-up assessment after training.

Methods

This was a simulation-based educational intervention, based on intraparticipant measurement, developed at two hospitals in the state of São Paulo, Brazil, between May 2016 and December 2017. The study protocol abided by the ethical standards established in the Declaration of Helsinki. This research followed STROBE recommendations for the methodological development of observational studies, "See Supplementary File 1".

Three data collection instruments were developed, based on American and European guidelines. These instruments were assessed by an expert panel of five nursing professionals, who were chosen based on the following inclusion criteria: having experience with CPR and simulation-based teaching. The authors incorporated the panel's suggestions to improve the instruments' clarity, objectivity and applicability; two of the questions in the theoretical instrument were excluded [6, 7].

The instrument created to assess participants' theoretical knowledge about CPR procedures included questions about recognizing cardiorespiratory arrests. Activating emergency medical services, positioning victims and responders, the correct sequence of CPR interventions, the compression-ventilation ratio, adequately using automated external defibrillators (AED), developing algorithms according to different types of cardiorespiratory arrests, using definitive airways, and administering drugs [6, 7]. This instrument was used at various points in the study: before and after the theoretical phase (IA and IB), before and after the practical phase (IC and ID), and at the follow-up assessment, 60 days after the simulation.

The researcher used a checklist to assess the actions of the groups during the simulations. It consisted of practical issues relative to the quality of cardiorespiratory arrest care, such as adequate CPR activities, the satisfactory use of the AED, cardiac monitoring, airway management, administering drugs, and closed-loop communication.

The authors created a third instrument to assess the training methodology as perceived by the participants. This included their opinions about the simulation itself, the importance of participating in the activity and how they developed a logical care sequence. This last section referred to knowledge about cardiorespiratory arrests, and how to activate emergency medical services, perform chest compressions, provide ventilation, use the AED, administer drugs, and deliver post-cardiorespiratory arrest care.

The study was conducted in nine steps, divided into theoretical and practical phases, as shown in **Table 1**.

Nine nurses were chosen to participate in a pilot test at a public hospital to assess the neces-

sary materials and equipment and the study steps. This allowed for adjustments to important aspects, such as the structure and location of the simulation scenario and the duration of the practical training phase.

Data was collected at a private 65-bed medium-complexity hospital, and all 47 staff nurses were invited to participate in the study. Initially, the convenience sample consisted of 20 participants, but 4 were later excluded because they did not complete all the steps. Thus, the final sample was 16 nurses. The inclusion criterion was: being a professional who was available to participate in all stages of the study. The authors excluded those who were on medical leave, maternity leave, or vacation during the period of the study. (**Table 2**)

Table 1. Study steps. São Carlos, São Paulo, 2018.

Study steps	Description
Firstphase	
1	Administering the theoretical instrument (IA) (30 minutes)
2	Theoretical approach to teaching CPR, demonstrating procedures (120 minutes)
3	Administering the theoretical instrument (IB) after the dynamic lesson (20 minutes)
15 days after the first phase	
5	Practical approach to teaching basic and advanced CPR procedures with individual mannequin training (120 minutes)
6	Carrying out the simulated scenario set up for cardiorespiratory arrest care, video recording, and filling out the checklist with the actions carried out by the group on scene (10 minutes).
7	Re-administering the theoretical instrument (ID) (20 minutes)
8	Debriefing and administering the instrument to assess teaching methodology (40 minutes)
60 days after the first phase	
9	Administering the theoretical instrument (60 days after practical phase) to assess long-term performance (20 minutes)

Table 2. Descriptive measures of correct answers over time. São Carlos, São Paulo, 2018.

Administering instruments	Minimum number of correct answers	Quartile 1	Median correct answers	Mean correct answers	Quartile 3	Maximum number of correct answers
IA	6	7	8.5	8.75	10	13
IB	10	14.5	16	15.56	18	19
IC	10	14.5	16	15.38	17.25	18
ID	11	16	17.5	16.94	19	20
After 60 days	09	12.75	15	14.62	17	19

IA: Pre-theory data collection instrument; IB: Post-theory data collection instrument; IC: Pre-practical phase data collection instrument; ID: Post-practical phase data collection instrument; After 60 days: Data collection instrument 60 days after the practical phase.

The training program was conducted in small groups of between five and ten participants, in situ, outside working hours. Two days were dedicated to the theoretical phase and two to practical training. Each group attended only one theoretical session and one practical session.

For steps 1, 2, and 3, the researchers used a room located in the hospital's administration building, adapting it to represent a realistic clinical setting with all the necessary resources, such as multimedia devices, a medium-fidelity mannequin, and devices to demonstrate procedures.

The practical phase (steps 4, 5, and 6) and strategy assessment phase (steps 7 and 8), in which the theoretical instrument was administered, were conducted two weeks after the theoretical phase. After answering the questionnaire, participants performed CPR maneuvers individually, using skills related to chest compressions, the use of manual resuscitators and the AED, and handling the crash cart.

To develop the simulation scenario (step 6), the participants were divided into two groups to make it easier to carry out the activity. The simulated case was described to them outside the training room right before they entered the simulation environment. The simulated scenario had been set up previously. During the simulation, a team member who played the part of a simulate patient, as well as a medium-fidelity mannequin, presented with cardiorespiratory arrest, providing the most realistic simulated environment possible. Trained collaborators played the roles of nursing technicians, doctors, desk clerks, and a second patient. The simulated patient acted according to the clinical case that triggered the realistic simulation. The scenes were filmed with the participants' consent and used later during debriefing.

The subgroups were only allowed to contact each other after everyone had carried out the simulation, preventing them from sharing information about the scenario. During the simulation (step 6), the

researcher used the checklist to identify whether important actions of the algorithm had been performed by the group.

After the simulation, the participants were given the theoretical instrument once again (step 7), followed by debriefing (step 8) based on the film footage recorded in step 6. Debriefing required that participants report their experience in the simulation activity in terms of its emotional, descriptive, evaluative, analytical and conclusion domains. A facilitator guided this step, and two other collaborators wrote down what the participants said for future descriptive analysis. At the end of debriefing, the participants answered the questionnaire to evaluate the simulation-based training methodology.

Follow-up assessment (step 9) took place 60 days after the theoretical and practical training sessions. At this time, the participants answered the theoretical data collection instrument to measure their performance after a given period.

The data collected in each step of the study were stored on a Microsoft Excel 2010 spreadsheet. Wilcoxon's nonparametric test was used for data analysis, with significance set at $p < 0.05$ for the checklist. Descriptive analysis was used to analyze the methodology assessment instrument.

Results

The 16 participants who made up the sample were between 24 and 52 years old. Regarding nursing experience, 7 participants had 1 to 3 years (43%), followed by 6 participants (38%) with 3 to 6 years, and 3 participants (19%) with over 6 years of experience. Most of the participants (12 - 75%) were surgical nurses.

The scores on the theoretical instrument improved throughout the study steps, as shown in **Table 1**, with emphasis on the post-simulation phase (ID), with a mean of 16.94 correct answers. Sixty days after the simulation, the participants scored lower

on the theoretical instrument, with a mean of 14.62 correct answers. The variable that presented the lowest level of correct answers at all assessment points was temperature management after cardiorespiratory arrest (hypothermia).

In step 6, with the checklist, some items of the algorithm were not observed in any of the simulation groups, such as closed-loop communication, stating possible causes of cardiorespiratory arrest, and basic CPR procedures.

The assessment of the teaching methodology (step 8) showed that the lowest score was that relative to care after cardiorespiratory arrest. Thus, it was the least-mentioned item during the simulation, according to the participants.

Data analysis demonstrated a difference in the proportion of correct answers between times IA and ID and between ID and 60 days after the simulation ($p < 0.05$). However, between times IB and ID, no significant differences were found ($p > 0.05$), demonstrating that training after time IA favored greater mastery by participants between IB and ID.

Discussion

The dynamic nature of simulation-based teaching methods goes against the traditional method, because individuals are given the opportunity to carry out interventions, develop skills, improve communication, and develop an ethical attitude in a controlled environment [4].

In the present study, most of the participants had less than six years of experience. The predominant location of practice was low- to medium-complexity care level units, which present fewer emergency situations. These findings conflict with the literature, which emphasizes the greater aptitude of nursing professionals for intensive care units and emergency rooms when caring for cardiorespiratory arrest patients [8].

Regarding the post-theory and post-practice steps, there was an increase in the mean number

of correct answers, showing the superiority of simulation over the theoretical approach. This finding corroborates that of a study [9] that compared the traditional and simulation-based teaching methods, which found that a single exposure to a simulation scenario promoted greater critical thinking, self-confidence, and consequently, improved performance of students.

The literature reports that an explanation of the satisfactory performance demonstrated by participants following simulations is that this method offers training in the development psychomotor skills. Moreover, it gives individuals an active role in their own learning, showing higher levels of correct answers after participating in simulated activities [10].

Absence of experience with emergency situations after participating in training sessions reduces the confidence gained after simulations [11]. Furthermore, such skills have been shown to wane 3 to 6 months after the intervention if not further developed or practiced frequently [5].

Therefore, performance analysis of the participants in the simulated scenario was assessed using a checklist with the actions that should have been implemented, and the results showed that none of the groups carried out the sequence of items as recommended by American [6] and European [7] guidelines for caring for cardiorespiratory arrest patients. Using tools to assess participants in scene provides a methodological framework [12] and determines the effectiveness of the teaching strategy, because one of the phases of the simulated scenario is to assess one's actions. The checklist showed that important items were skipped by the participants, such as closed-loop communication, mentioning possible causes of the arrest, checking the patient's pulse and verifying heart rhythm every two minutes, ventilating every six seconds when patient needed advanced airways, carrying out 2 ventilations after the first 30 compressions and checking the carotid pulse in under 10 seconds.

Closed-loop communication is one of the essential principles for teams to deliver quality CPR care, minimizing the incidence of errors during emergencies [5].

Nurses must be knowledgeable about the possible causes of CRA to provide a treatment approach in accordance with the reversible circumstances that culminated in this outcome [5]. Following the sequence of actions recommended by American and European guidelines improves the success of CPR procedures and chance of survival [6, 7].

At the end of the simulation, the researchers conducted a debriefing session based on the emotional, evaluative, analytical, descriptive and conclusion aspects of the experience. In the emotional domain, some common phrases were "flustered," "unstable," "worried," "didn't know anything," "stressed," and "nervous," showing the emotional impact and powerlessness felt by the participants when caring for a cardiorespiratory arrest victim and lacking the initiative to make quick decisions. This finding corroborates a study that showed similar emotional repercussions, which proved essential to underpinning the participants' self-assessment of their knowledge and actions [13].

The evaluative and analytical contexts included words such as "good dynamics," "knowledge," "teamwork," "lack of leadership," "big picture," "forgetting to compress," "forgetting to keep calm," and "knowing the algorithm for cardiorespiratory arrest care." These expressions help participants identify both the positive and negative aspects of the simulated scenario, emphasizing an essential step in learning the recently-trained techniques and possibly reducing errors in a second simulation [14].

Debriefing allows participants to recognize the strong and weak points of their actions. Based on their accounts, they can reflect and critically assess their individual and group performance during the scenario [15]. This was also the case in another study [16], which showed higher satisfaction among

participants in the debriefing group than those who only carried out self-reflection.

The assessment of the conclusion domain showed phrases such as "realize your mistakes," "one simulation is not enough," "know your limitations," "important activity," "reflection," and "organization." These terms corroborate the assessment made by nursing students in another study, who emphasized the importance of simulation activities to enhance learning and improve their actions in future situations [17]. Furthermore, the method allows participants to discern and learn through the simulated experience and enables them to identify gaps between theory and practice [14]. Furthermore, in the descriptive domain, words such as "unpreparedness," "disorganization," and "lack of leadership" reflect the disordered thinking of participants after the simulation, pulling them out of the simulation and into a real-life context. During debriefing, they are requested to report on the experience, which enables learning at various levels, an essential step in the success of the simulation activity [18].

A study conducted with 14 European simulation centers also placed debriefing as an essential element of successful learning in simulation activities. However, if conducted poorly, it can result in negative repercussions for participants [18].

The scores on the theoretical knowledge questionnaire decreased between the post-practical assessment and the follow-up assessment. A similar finding was shown in a study in which the knowledge presented by the participants deteriorated after the eighth week post-intervention [19]. Regular CPR training every six months provides adequate health team training when compared with professionals who received training at longer intervals [16].

Despite decreased performance of nurses at 60 days post-training, this score did not reach the pre-test level. This corroborates the findings of a study conducted with a similar teaching method, which showed decreased correct answers at 6 and 12 months post-training, emphasizing the need for

repeated training on the subject, especially among professionals who work in sectors that do not usually handle this type of emergency [20].

Simulations contribute to patient safety culture, reduce costs, and promote the discussion of ethical issues. Thus, they should be a solid part of ongoing education programs provided by health institutions [16].

Limitations of the present study include the small number of patients. This occurred because the training sessions were held outside of working hours, making it so that not all the nurses at the institution could participate.

Conclusion

The simulation-based teaching method proved to be satisfactory and effective in the work environment of nursing professionals. It improved performance throughout the nine study steps, and higher scores were obtained after the theoretical and simulation-based training.

Two months after the simulation, participant performance decreased. However, it did not reach pre-test levels, which shows that simulations are an effective educational intervention for CPR training for nurses in the hospital setting.

Relevance to Clinical Practice

The relevance to demonstrate that health professionals need frequent training to develop technical skills and effective communication in cardiorespiratory arrest care.

What does this paper contribute to the wider global clinical community?

This study contributed to the development and qualification of the nursing team by aggregating essential values for the process of good practices, using in a simple way the theory and practice in each procedure, in order to obtain a safe care to the patient.

Conflicts of interest and source of funding

This study does not present conflicts of interest and obtained self-financing.

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