UFSM

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REVISTA DE ENFERMAGEM DA UFSM

ISSN 2179-7692
OPEN ACCESS

Rev. Enferm. UFSM, v.16, e2, p.1-17, 2026 •
Submission: 03/06/2025 • Acceptance: 11/18/2025 • Publication: 12/18/2025

Experience report

In situ simulation of cardiopulmonary resuscitation in the intensive care unit: experience report*

Simulação *in situ* de ressuscitação cardiopulmonar na unidade de terapia intensiva: relato de experiência

Simulación in situ de reanimación cardiopulmonar en la unidad de cuidados intensivos: informe de experiencia

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* Extracted from the thesis "In situ simulation as a strategy for continuing education of nursing professionals in pre-hospital care and intensive care units," Graduate Nursing Program, Federal University of Paraná, 2025.

Abstract

Objective: report on the implementation of in situ simulation (SIS) of cardiopulmonary resuscitation (CPR) in adult intensive care units (ICUs) at a university hospital in northeastern Brazil. **Method:** descriptive study, experience report type, derived from a doctoral thesis, conducted with 32 nursing professionals. In the first stage, study material and theoretical-practical training in CPR were offered. In the second stage, SIS was applied between July and October 2023. **Results:** Improvements in knowledge and technical and non-technical skills were identified, in accordance with American Heart Association guidelines, as well as participant satisfaction and integration between technicians and nurses. However, the need for beds to be available for the implementation of SIS was highlighted as a challenge. **Conclusion:** The strategy showed potential for training teams in critical settings, such as ICUs. Considering the scarcity of research in Brazil, this experience contributes to the expansion of SIS in other hospitals in the country.

Descriptors: Simulation Training; Heart Arrest; Intensive Care Units; Education, Continuing; Patient Simulation

Resumo

Objetivo: relatar a implementação da simulação *in situ* (SIS) de ressuscitação cardiopulmonar (RCP) em unidades de terapia intensiva (UTI) adulto de um hospital universitário do Nordeste do Brasil. **Método:** estudo descritivo, tipo relato de experiência, derivado de tese de doutorado, realizado com 32 profissionais de enfermagem. Na primeira etapa, ofertou-se material de estudo

e treinamento teórico-prático em RCP. Na segunda, a SIS foi aplicada entre julho e outubro de 2023. **Resultados:** identificou-se aprimoramento do conhecimento, das habilidades técnicas e não técnicas, conforme diretrizes da *American Heart Association*, além de satisfação dos participantes e integração entre técnicos e enfermeiros. No entanto, como desafio, ressaltou-se a necessidade de leitos disponíveis para execução da SIS. **Conclusão:** a estratégia mostrou potencial para qualificar equipes em cenários críticos, como UTI. Considerando a escassez de pesquisas no Brasil, esta experiência contribui para a expansão da SIS em outras instituições hospitalares do país.
Descritores: Treinamento por Simulação; Parada Cardíaca; Unidades de Terapia Intensiva; Educação Continuada; Simulação de Paciente

Resumen

Objetivo: informar sobre la implementación de la simulación in situ (SIS) de reanimación cardiopulmonar (RCP) en unidades de terapia intensiva (UTI) para adultos de un hospital universitario del noreste de Brasil. **Método:** estudio descriptivo, tipo informe de experiencia, derivado de una tesis doctoral, realizado con 32 profesionales de enfermería. En la primera etapa, se ofreció material de estudio y formación teórico-práctica en RCP. En la segunda, se aplicó la SIS entre julio y octubre de 2023. **Resultados:** se identificó una mejora en los conocimientos y las habilidades técnicas y no técnicas, de acuerdo con las directrices de la American Heart Association, además de la satisfacción de los participantes y la integración entre técnicos y enfermeros. Sin embargo, como desafío, se destacó la necesidad de disponer de camas para la ejecución del SIS. **Conclusión:** la estrategia demostró su potencial para capacitar equipos en entornos críticos, como las UCI. Teniendo en cuenta la escasez de investigaciones en Brasil, esta experiencia contribuye a la expansión del SIS en otros centros hospitalarios del país.
Descriptores: Entrenamiento Simulado; Paro Cardíaco; Unidades de Cuidados Intensivos; Educación Continua; Simulación de Paciente

Introduction

High-quality cardiopulmonary resuscitation (CPR), as recommended by the latest guidelines from the American Heart Association (AHA), is directly related to higher survival rates and lower morbidity in cases of cardiopulmonary arrest (CPA).[1]

To this end, it is necessary to conduct training using clinical simulation (CS), covering all levels, from basic life support to advanced life support, in order to develop both technical skills (CPR quality indicators) and non-technical skills related to the human factors involved in resuscitation, such as effective communication, situational awareness, leadership and teamwork, task management, and decision-making.[2]

In this context, in situ simulation (ISS) has been used by healthcare professionals as an effective teaching method, which consists of conducting training in the actual clinical environment where care is provided. It stands out for ensuring high fidelity to

the environment, allowing realistic reproduction of simulated scenarios and enabling the participation of professionals in their own workplace.[3]

Thus, the implementation of SIS should be guided by the specific objectives and skills to be developed by the target audience.[4] Especially in ICUs, where CPR occurs most frequently, it is necessary for healthcare professionals to receive continuous training. Recent studies5 have demonstrated the benefits of SIS in improving the skills and empathy of ICU professionals.

Evidence shows that SIS, either alone or combined with traditional training, can provide effective learning, with greater agility in customer service and better team performance.[1]

In this context, when applied to the ICU environment, SIS proves to be relevant by contributing to the improvement of knowledge, technical skills, and attitudes of professionals, promoting safer and higher quality care. To achieve these results, qualified facilitators, structured debriefing, and action plans developed by the nursing team are essential.[5]

In view of the above, this study aimed to report on the implementation of the CPR SIS in the adult ICUs of a university hospital in northeastern Brazil.

Method

This is an experience report study, derived from the doctoral thesis entitled “In situ simulation as a strategy for continuing education of nursing professionals in pre-hospital care and intensive care units: a quasi-experimental study.” The original study was characterized as quasi-experimental, of the before-and-after type, with a quantitative approach and a single arm, carried out through the application of SIS with nursing professionals from two adult intensive care units, totaling 20 beds, belonging to a university hospital located in the Northeast region of Brazil, selected according to the availability of beds for the execution of SIS.

Based on this design, we sought to evaluate the effect of SIS on self-confidence, anxiety, the development of clinical skills in nurses and nursing technicians, as well as on the clinical judgment of nurses when working together in the same setting.

The SIS occurred in the General and Clinical-Surgical ICUs (each with ten beds), not including the Infectious and Parasitic Diseases ICU (DIP) due to the unavailability of vacant beds.

The sample size was calculated using the equation for studying two paired proportions (before and after). All nursing professionals working in the three adult ICUs were considered, totaling 39 nurses and 164 nursing technicians.

The parameters used included a 95% confidence level and 80% test power. Based on these criteria, a sample of 32 participants was obtained, in a 3:1 ratio, i.e., three technicians for each nurse.

The inclusion criterion was to be a nurse or nursing technician working in adult ICUs. Professionals who were on bonus leave, maternity leave, or sick leave during the data collection period were excluded, as were those who did not work directly in care.

The first stage of the study, conducted between February and April 2023, consisted of theoretical and practical CPR training at the university hospital, organized into day and night shifts. Professionals were invited to participate through WhatsApp groups, where the available dates were announced, along with the link and QR code for registration.

In addition, participants received study materials via WhatsApp, including the document “Highlights of the 2020 AHA Guidelines for CPR and Emergency Cardiovascular Care (ACE)”1 and a video tutorial (MP4 format) on the use of the multiparametric defibrillator, produced and recorded by the researcher. The entire nursing team, composed of nurses and technicians, had access to the content made available.

The training covered CPR recognition, the chain of survival, and airway management. After the training, the presentation files were shared, and the professionals were informed about the future implementation of SIS, the date of which was not disclosed. All theoretical and practical training and SIS were conducted by the researcher, who has training in emergency care and clinical simulation.

In the second stage, the data collection team, composed of six previously trained nursing students, assisted in the application of the instruments and the organization of the SIS, carried out between July and October 2023.

The students participated in theoretical and practical CPR training on dates and times that differed from those of the nursing professionals and were trained in the use of data collection instruments, being assigned the roles of observer, collector, and person responsible for filming.

Participants acted in a scenario developed based on the League for Nursing (NLN)/Jeffries Simulation Theory, the INACLS (International Nursing Association for Clinical Simulation and Learning) Recommended Practice Standards, and the AHA guidelines.[1]

In light of these references, the simulation scenario is structured around seven fundamental dimensions: context, background, design, simulation experience, role of the facilitator and educational strategies, participants, and results.[6]

The INACSL Standards also indicate essential steps for implementing simulation, including pre-briefing (preparation and briefing), simulation design, facilitation, goal setting, outcomes, and debriefing.[7]

To validate the scenario developed, a pilot test was conducted with the female academics who were members of the research team, in order to avoid possible biases. Based on this test, it was possible to identify and correct flaws, such as the need to keep the beds properly covered and to position the resuscitation board from the emergency cart near the bed.

The participating professionals signed the Free and Informed Consent Form (FICF) and the Image and Voice Use Request Form for Research. For data collection, a sociodemographic questionnaire, the Self-confidence Scale, and the State-Trait Anxiety Inventory (STAI) were used, administered before the briefing.

After the SIS, participants responded again to the Self-confidence Scale and the State Anxiety Inventory. The clinical skills and judgment of the nurses were assessed by the researcher using the Creighton Competency Evaluation Instrument (CCEI) and the Lasater Clinical Judgment Rubric during the SIS and, subsequently, with the support of recorded videos and the facilitator's checklist.

To implement the SIS, the researcher sent messages via WhatsApp to supervisors to confirm bed availability and staff exchanges. However, the team had to return several times due to unexpected bed occupancy and complications with critically ill patients.

Thus, SIS sessions in the morning took place after initial nursing care at the beginning of the shift; those in the afternoon took place after family visits to the ICU; and those in the evening took place after the shift change. During the intervention, half of the team provided care to patients, while the other half participated in SIS.

The collector assisted in completing the instruments, and the person responsible for filming recorded all SIS in audio and video. The observer used a checklist to evaluate the participants' actions, based on the AHA's CPR script and algorithm.1 Each item analyzed was recorded with the options “yes” or “no”.

Before the SIS, a 10-minute briefing was held with a brief practical demonstration of how to use the manual defibrillator. Participants were also given a printed, color copy of the CPR algorithm for adults so that they could review the content.

The study is part of the project “Multidisciplinary Clinical Simulation: Creation and Validation of Models, Scenarios, and Assessment Instruments” and was approved by the Research Ethics Committee of the Federal University of Paraná, in accordance with Resolution No. 466/2012, under opinion CEP: 5.908.817 and CAAE: 51163921.7.0000.0102.

Results

The objectives of the SIS were aimed at assessing the knowledge and developing the technical and non-technical skills of professionals, which are essential for treating patients in cardiac arrest. In this context, participants were expected to demonstrate fundamental competencies, covering the cognitive, psychomotor, and attitudinal domains.

Among these skills, the following stand out: medical history and recognition of cardiac arrest, team activation, high-quality CPR, defibrillation, correct execution of the adult cardiac arrest algorithm sequence, initiative, closed-loop communication, and proper application of post-cardiac arrest care.

Participants were divided into nurses (n=8) and nursing technicians (n=24), working together in the same CPR scenario. A total of 32 professionals participated, and SIS was applied in eight rounds. The facilitator also performed the role of

medical director, prescribing the medications used in the AHA adult CPR algorithm.[1] The average time for the scenario was 10 minutes.

On the day of the SIS, the facilitator, accompanied by the data collection team, introduced herself to the nurse on duty and then began setting up the scenario, which was designed to replicate the characteristics of a real hospital bed. An empty bed was covered and the Little Anne QCPR Laerdal manikin, specifically designed for CPR training, was used.

Following the preparation of the setting, the necessary materials for SIS were arranged, such as a bag valve mask (BVM) device with reservoir, silicone oxygen tube, 100% non-rebreathing mask, and a venous access kit containing a kidney dish, saline solution, equipment, medications, and procedure gloves. The mannequin was monitored and maintained with the 100% non-rebreathing mask. In addition, two two-step ladders were positioned near the bed to facilitate access.

The SIS were conducted as follows: the facilitator presented a clinical case of a 50-year-old man admitted to the ICU for treatment of a respiratory infection. The patient is wearing a non-rebreather mask and has peripheral venous access in his right upper limb (RUL).

Following the presentation of the case, the facilitator simulated the patient's voice, who reported sudden onset of chest pain in the substernal region, radiating to the left upper limb, accompanied by sweating and dyspnea. Showing anxiety, the patient called the nurse, but soon presented a decrease in level of consciousness, followed by CPR with shockable rhythm.

During the scenario, the facilitator provided some important clues, such as informing the nurse that the patient had become unresponsive and had stopped talking. In addition, it was mentioned that the identified CPR rhythm was ventricular fibrillation (VF).

The same clinical case was used in all SISs. During all CPR cycles, the identified rhythm remained VF. The scenario followed all steps of the CPR algorithm for adults with shockable rhythm, ending after return of spontaneous circulation (ROSC). In total, five cycles of CPR were performed, with a ratio of 30 chest compressions to 2 ventilations (30:2), since the patient did not have an advanced airway.

The actions planned for nurses included taking the patient's medical history, recognizing CPR, alerting the team, initiating CPR and defibrillation, considering Federal Nursing Council Resolution (COFEN) No. 704 of 2022,[8] "which regulates the actions of nursing professionals in the use of defibrillation equipment in the care of individuals in cardiac arrest".

With regard to the actions related to the nursing technician responsible for medication, the professional was tasked with taking the emergency cart and defibrillator to the nurse, in addition to continuing chest compressions. Subsequently, he administered the medications through venous access, as requested by the doctors.

During the scenario, the facilitator informed that the doctor had been unable to intubate the patient. In the meantime, two nursing technicians took turns performing chest compressions and ventilations until CPR was completed.

The debriefing lasted an average of 20 minutes and was guided by the PEARLS (Promoting Excellence And Reflective Learning in Simulation) health debriefing tool.[9] It was held at the end of the SIS with the professionals and the facilitator to discuss and analyze the simulated experience and reflect on the practice experienced.

As for the debriefing process, it took place next to the bedside, with participants standing. On some occasions, it coincided with family visiting hours, which meant that the nurse was unable to welcome the families.

During the SIS, professionals expressed satisfaction with the training provided, especially with regard to the knowledge acquired. Several participants demonstrated that they had assimilated the main recommendations covered in the theoretical and practical training, which highlighted the success of the teaching-learning process. There was also good rapport among team members, whose familiarity with their usual work team contributed to a relaxed and collaborative environment.

Among the positive and negative points observed during the intervention, the researcher's prior contact with most of the participants, established during the theoretical and practical training, stands out. This approach favored acceptance, motivation, and voluntary adherence to SIS.

During the debriefing, participants were able to clarify doubts and reflect on the strengths and weaknesses identified in the care provided. In addition, they suggested expanding simulation training to other sectors of the hospital, highlighting its importance and the need for continuous training in CPR.

On the positive side, they highlighted the prior definition of each professional's roles, which contributed to the organization of the scenario and allowed for the simultaneous performance of the actions outlined in the CPR algorithm. This approach enabled each team member to act according to their technical, ethical, and legal competencies.

From this perspective, nurses reported that SIS differs from care in real situations. They mentioned discomfort in taking the lead during CPR and unfamiliarity with the manual defibrillator—difficulties justified by the fact that, in daily practice, the procedure is performed exclusively by the doctor on duty.

In addition, they pointed out the limited autonomy of nursing in hospital routines and concerns about the instability of the clinical condition of hospitalized patients.

Regarding the actions of nurses, it was observed that some failed to perform important steps, such as asking questions during the medical history, checking the pulse, and positioning the resuscitation board.

On the other hand, it was found that teams in which nurses demonstrated leadership and mastery of technical and non-technical skills in performing CPR performed better during SIS. However, teams in which nurses showed insecurity or lack of leadership performed worse.

Regarding the performance of nursing technicians, some difficulties were identified in performing high-quality CPR. Among the main ones, the difficulty in alternating compressions every two minutes stood out. In addition, flaws were observed in the technique of placing and sealing the mask, as well as chest compressions that were too deep, had an inappropriate (slow) rhythm, or were performed with incorrect hand positioning.

The nursing technicians responsible for administering medications demonstrated skill in applying the 20 ml bolus infusion of saline solution. This performance can be attributed to the fact that this function is traditionally

performed by nursing professionals during CPR, reflecting their experience and competence in performing this task.

Among the specific objectives related to technical and non-technical skills, initiative and closed-loop communication with the team are considered to have been fully achieved. The following were partially achieved: medical history and recognition of CPR, team activation, high-quality CPR, defibrillation, correct execution of the adult CPR algorithm sequence, and appropriate application of post-CPR care.

It was observed that, despite individual limitations, participants demonstrated commitment and dedication when performing SIS based on their prior knowledge. They acknowledged the mistakes made and pointed out that, in practice, the presence of nursing or medical students, as well as a medical professional, facilitates the performance of CPR. This aspect reinforces the importance of joint training between nursing professionals, promoting integrated and effective performance in the same scenario.

ICUs face a constant challenge due to high staff turnover. At the end of their contracts, temporary professionals are replaced, which hinders the continuity of professional training and the improvement of team skills. Nevertheless, when evaluating the experience, it was concluded that the teams demonstrated a high level of motivation and interest in participating in the simulated activity. In addition, they recognized the need for training and adherence to the updated CPR algorithm at the institution.

Discussion

This experience report highlights SIS as a viable continuing education strategy for nursing professionals in the ICU CPR setting. The scientific literature indicates that SIS has been used to assess clinical skills in complex settings, test new areas of clinical practice, equipment, technologies, and procedures, and develop technical and non-technical skills, both individually and as a team. Among its advantages are the promotion of better integration among team members, the creation of opportunities for improvements in the work process, and the consolidation of theoretical knowledge through simulated practice.[4]

An integrative review study investigated the use of SIS worldwide, focusing on its applicability in the health field between 2012 and 2021. A total of 358 articles found in the PubMed, SciELO, LILACS, and Web of Science databases were analyzed, of which 190 met the inclusion criteria and were examined. However, only five Brazilian studies addressed the application of SIS in hospital urgent and emergency situations, highlighting the need for greater application and dissemination of this teaching strategy in Brazil.[3]

Thus, this study demonstrated the improvement in knowledge and the development of technical and non-technical skills promoted by SIS, both individually and in joint teamwork. This result was influenced by the leadership exercised and the qualifications of the nurse, directly impacting the performance of the nursing teams.

The implementation of a SIS within an ICU requires the availability of a vacant bed and the absence of complications at the scheduled times. From this perspective, research conducted in the Coronary Care Unit of a teaching hospital pointed out that the need to temporarily block a hospital bed for the performance of SIS constitutes a weakness in the organization of the activity.[10]

During the implementation of SIS, nurses demonstrated insecurity in handling the manual defibrillator, attributed to a lack of practical experience with the equipment. This difficulty highlights the need for periodic training to develop technical skills and greater confidence in using the equipment.

In this regard, a cross-sectional study conducted with nurses working in ICUs in Saudi Arabia aimed to explore the level of comfort of teams in handling specific equipment in their work environment. The results showed that, among the 297 nurses interviewed, 73.9% reported having received training in the use of cardiac defibrillation devices, which was reflected in a high level of self-reported comfort when operating this equipment in their ICUs.[11] This evidence reinforces that the level of comfort in using equipment is directly related to regular practice and training.

According to COFEN Resolution No. 704 of 2022,[8] “nursing staff are permitted to use automatic external defibrillators (AEDs).” In the absence of an AED, the use of a

manual defibrillator for defibrillation is restricted to nurses within the nursing team. To perform this procedure, the team must be trained through an in-person course with a theoretical and simulated practical approach.

It is worth highlighting the participants' reports on satisfaction and motivation associated with the prior definition of each professional's roles. According to the AHA, the distribution of roles and organization of the multidisciplinary team during CPR are fundamental for the development of high-performance teams, providing better clinical outcomes.[1,12]

To improve survival after CPR, it is essential to teach both technical and non-technical skills, such as situational awareness, team management, and decision-making, taught in simulation sessions.[2]

With regard to preparation, learning resources should be provided to participants, such as study materials, lectures, or audiovisual resources, in order to provide security, comfort, and minimize anxiety during the implementation of the simulation.[13]

In the context of this study, the researcher planned the simulated intervention in a structured manner, enabling professionals to be properly prepared by studying the teaching materials provided and undergoing theoretical and practical training.

Instructor qualifications are essential for learning in various areas of education, but there is little evidence of their impact on CPR training. Three factors are essential in the development of these instructors: selection of qualified professionals, adequate initial training, and continuous updating.[2]

In the present study, the facilitator's qualifications proved essential in promoting team involvement and engagement, contributing directly to favorable outcomes and meaningful learning.

During the implementation of the SIS, the researcher was invited to conduct new simulations in other hospital wards, due to the dissemination by ICU participants of the satisfaction and meaningful learning provided by the simulated experience in the CPR scenario.

It should be noted that the sample size planned for the study was duly achieved and that SISs carried out in other sectors were not included as part of the research. However, there is evidence of the possibility of replicating SIS as a continuing education strategy in the hospital, beyond the scope of research.

On social media, the researcher received positive feedback from the professionals who participated in the study, including reports on the transformation of their practices and their motivation to seek further knowledge and improvement. Some participants, inspired by the experience, enrolled in courses in the field of urgent and emergency care offered at other institutions.

Continuing education is essential for patient safety, although staff turnover caused by temporary contracts requires frequent training and can affect the quality of processes.[14]

In this vein, research conducted with nursing professionals in a surgical center at a university hospital in the Southeast region pointed out that the absence of public competitive examinations compromises professional training, since the knowledge and skills acquired during on-the-job training are discontinued due to contract termination.[15]

In contrast, a study on the implementation of SIS in continuing education for nursing professionals, conducted in an ICU at a public teaching hospital in southern Brazil, highlighted that this practice is not only effective and innovative, but also a form of simulation applicable in critical contexts.[16] In addition, the debriefing stage is essential for fostering the development of reflective thinking in nursing, contributing to meaningful learning.[17]

In this context, the main challenge of the present study was the dependence on vacant beds for the implementation of the SIS, since the scheduling of scenarios with supervisors had to be adjusted according to bed availability, which caused interruptions in the established schedule and prolonged the time required for data collection.

One limitation is that SISs were conducted in ICUs, at the patient's bedside, which, although it increased the realism and fidelity of the scenario, may have caused interference, such as distractions, discomfort, or restrictions on the team's performance, potentially impacting the professionals' performance.

Furthermore, the application of SIS was restricted to the ICU setting of a single university hospital in the region. Despite these limitations, the intervention promoted greater integration between technicians and nurses, who worked together in the same setting, improving teamwork and broadening understanding of roles and responsibilities.

The study highlights that SIS promotes the development of clinical skills and strengthens the quality of care in highly complex settings, such as ICUs, with a significant impact on professional practice and fostering teamwork among nursing staff.

Conclusion

The study demonstrated that SIS is a teaching strategy applicable to the training of nursing professionals working in the ICU. Its application contributed to the improvement of knowledge and the development of technical skills, in line with AHA guidelines, in addition to promoting the improvement of non-technical skills, such as leadership and teamwork.

The integration between technicians and nurses, working together in the same setting with predefined roles, facilitated the consolidation of learning in a realistic clinical environment. This approach not only promoted participant satisfaction, but also had a positive impact on the improvement of professional practice.

Despite the challenges faced, such as the need for vacant beds, the experience highlighted the potential of SIS for training hospital teams working in highly complex critical scenarios, such as ICUs.

The study contributes to the dissemination of knowledge about SIS in the Brazilian context, where there is still a lack of studies on the subject. Based on the results presented, other hospital units may adopt this teaching strategy in the continuing education of nursing professionals.

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Editor in Chief: Cristiane Cardoso de Paula
Associate Editor: Silviamar Camponogara

How to cite this article

Carvalho AEL, Silva WJC, Bucco M, Vilarinho JOV, Mendes JO, Gonçalves MAS, Chevonik IE, Felix JVC. In situ simulation of cardiopulmonary resuscitation in the intensive care unit: experience report. Rev. Enferm. UFSM. 2026 [Access at: Year Month Day]; vol.16, e2:1-17. DOI: https://doi.org/10.5902/2179769291078