Basic life support training for intensive care unit nurses at a general hospital in Tabriz, Iran: a best practice implementation project

Neda Kabiri[1] • Sakineh Hajebrahimi[1,2] • Maryam Soleimanpour[1] • Roghayeh Asghari Ardebili[3] • Nasim Hajipoor Kashgsaray[4] • Hassan Soleimanpour[5]

[1]Research Center for Evidence-based Medicine, Iranian EBM Centre: A JBI Centre of Excellence, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran, [2]Urology Department, Helsinki University, Helsinki, Finland, [3]Department of Anesthesiology and Critical Care Medicine, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran, [4]Emergency and Trauma Care Research Center, Tabriz University of Medical Sciences, Tabriz, Iran, and [5]Medical Philosophy and History Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

ABSTRACT

Introduction and objectives: Basic life support (BLS) is foundational to the care delivered to cardiac arrest victims. This study evaluated current practices and implemented best practices related to BLS training for intensive care unit (ICU) nurses in a general hospital in Tabriz, Iran.

Methods: This interventional before-after study was informed by the JBI Evidence Implementation Framework. An audit, feedback, and re-audit strategy was used to measure baseline compliance with best practices, develop an implementation strategy to address gaps in compliance, and undertake a final evaluation to measure changes in compliance. The JBI Practical Application of Clinical Evidence System (JBI PACES) and situational analysis Getting Research into Practice (GRiP) tool were used to support data collection and implementation planning. There were 13 evidence-based criteria and a sample of 9 ICU nurses.

Results: The baseline audit revealed gaps between current practice and best practice in 9 of the 13 criteria. Barriers included insufficient education tools and programs, insufficient supervision, lack of skills laboratories, and a lack of continuous BLS education. Improvement strategies included providing a human stimulator manikin, developing an education program for nurses, as well as establishing a cardiopulmonary-cerebral resuscitation department, a skills laboratory, and continuous BLS education based on the American Heart Association guidelines. The follow-up audit revealed improvement of 100% across all criteria.

Conclusions: This project indicates that a clinical audit is effective for assessing evidence-based BLS education for ICU nurses, thereby improving resuscitation performance and patient outcomes.

Spanish abstract: http://links.lww.com/IJEBH/A213

Keywords: basic life support; best practice; continuous education; evidence-based practice; implementation science

JBI Evid Implement 2024; 22(0):1–10.

What is already known?

- Basic life support (BLS) training is an essential skill that health care providers need to know.
- Providing effective cardiopulmonary resuscitation to patients with cardiac arrest or pulmonary arrest is a stressful task that depends on several issues, such as training materials, students, professors, educational fields, and applied technologies.
- Barriers and facilitators to BLS training could affect the quality of care and the success rate of cardiopulmonary resuscitation.

What this paper adds

- Health care providers are not routinely trained in BLS skills and there are no suitable training materials.
- Barriers to best practice regarding basic life support training may include insufficient education tools and programs, insufficient supervision, and lack of skill laboratories in hospitals.

Correspondence: Hassan Soleimanpour, h.soleimanpour@gmail.com

The authors declare no conflicts of interest

DOI: 10.1097/XEB.0000000000000434

- Strategies to improve compliance with evidence-based practice regarding BLS training may include providing a human stimulator manikin, educational sessions, workshops and conferences, establishing cardiopulmonary-cerebral resuscitation, and establishing skills labs in hospitals.

INTRODUCTION

Cardiac arrest can be followed by pulmonary arrest in rapid succession. Cardiopulmonary resuscitation (CPR) includes a series of actions to restore the function of the heart, lungs, and brain, in addition to preventing brain death, which is the ultimate goal of any CPR procedure. Many factors influence the effectiveness of a CPR procedure, such as lack of specialized personnel, delay in initiation of circulation, and circulation techniques.[1]

Medical education in the field of CPR depends on several issues, such as training materials, students, professors, educational fields, and applied technologies.[2] CPR is an essential component of basic life support (BLS), which is a level of first-aid resuscitation that is applied in the interim before defibrillation and advanced life support can be performed. It has been shown that health care providers with high self-confidence in performing CPR provide high-quality BLS in terms of compression depth, compression frequency, and manual ventilation.[3] Therefore, improving self-confidence and CPR training may improve CPR outcomes. There are several ways to teach CPR, including theoretical lectures and simulation. CPR simulation manikins have been developed in recent years and are increasingly available; however, the quality and outcome of such simulation methods are still unclear.[3]

According to guidance from the International Liaison Committee on Resuscitation, there are ten critical steps to improve in-hospital cardiac arrest care. These include (1) building and supporting governance and infrastructure for a resuscitation program, (2) collecting data to measure and improve resuscitation processes and outcomes, (3) implementing effective education and training for resuscitation, (4) establishing patient and family goals of treatment early and reassessing often, (5) stopping preventable in-hospital cardiac arrest, (6) developing and deploying an effective resuscitation response system, (7) delivering guideline-based resuscitation care, (8) delivering guideline-based post-cardiac arrest care, (9) implementing a person-centered culture of excellence in care, and (10) ensuring the well-being of health care professionals.[4]

Nurses play a critical role in ensuring an effective in-hospital CPR response. They are the first to be present at the arrested patient's bedside, they usually act as an articulator among resuscitation team members, and also activate the emergency call. Therefore, to ensure good outcomes for in-hospital CPR response, nurses must be skilled in performing CPR and hospitals should emphasize nurses' training and competency at all levels regarding CPR.[5]

The intensive care unit (ICU) provides specialized care and treatment in hospital. Cardiac arrest is a common and highly morbid event in ICU, with patient outcomes being generally worse than those in monitored inpatient wards. It is therefore critical to provide training courses for nurses, especially those who work in ICU. Moreover, such training courses should be repeated over time.[6,7]

Studies show that in Iran, there is a low level of knowledge and skills among ICU nurses regarding CPR.[8,9] The results of one study indicated that ICU nurses have generally poor skills in BLS, which could be improved within 6 months after BLS training.[10] Therefore, CPR training for ICU nurses is a high priority for nurses in university hospitals in Iran.[6] Given the importance of BLS training for ICU nursing staff, particularly in a low- to middle-income country such as Iran, this project aimed to assess the performance of ICU nurses regarding BLS training. The project was conducted at a general hospital in Tabriz, Iran and was conceptually guided by the JBI Model of Evidence-Based Healthcare.[11–15]

OBJECTIVES

The aim of this project was to evaluate current practices and implement best practices related to BLS training for ICU nurses in a general hospital in Tabriz, Iran. The specific objectives were to:

- Determine current compliance with best practice recommendations regarding BLS training for ICU nurses.
- Identify barriers and facilitators to improving compliance and develop strategies to address non-compliant areas.
- Evaluate changes in compliance with best practice recommendations following the implementation of improvement strategies.

METHODS

This interventional before and after evidence implementation project used the JBI Evidence Implementation

Framework.[15] The JBI framework is grounded in an audit and feedback process, along with a structured approach to the identification and management of barriers to comply with recommended clinical practices. The framework consists of seven stages: (1) identification of practice areas for change, (2) engaging change agents, (3) assessment of context and readiness to change, (4) review of practice against evidence-based audit criteria, (5) implementation of changes to practice, (6) re-assessment of practice using a follow-up audit, and (7) consideration of the sustainability of practice changes. The project used the JBI Practical Application of Clinical Evidence System (JBI PACES) and the JBI Getting Research into Practice (GRiP) audit and feedback tool.

Setting

This implementation project was conducted in a 15-bed general ICU ward of the largest referral center for critical patients in Tabriz, Iran (Imam Reza General Hospital). This 844-bed hospital receives approximately 40,000 patients every year, with 5,000 admissions and a bed occupancy rate of 96% in the ICU ward.

Ethical considerations

The project was registered as a quality improvement activity within the participating hospital and therefore did not require ethical approval. However, participation in the audit was voluntary and approval was obtained from patients, caregivers, and health care providers before data collection began. Participants' identities were kept confidential and anonymous.

Implementation planning

Phase 1: Identification of the practice area for change

The project leader, who was aware of the problems within the ward, identified four important issues, and of these, the current problem was chosen for implementation.

Phase 2: Engaging change agents

The project team members, who were considered the main change agents, consisted of a group of five intensivists, one nurse, and the chief researcher (project leader). All nine nurses who participated in the project worked in ICU. The project leader was also responsible for providing training materials for the BLS training course; gathered data; and analyzed the data.

Phase 3: Assessment of context and readiness to change

In this phase, the context in which the project would be implemented was assessed and all participating nurses were informed about the project goals and outcomes.

Baseline assessment and implementation

Phase 4: Review of practice

A JBI evidence summary[16] of the best available evidence was used to develop 13 audit criteria, which were then and translated into Persian by one of the researchers. Out of the 26 nurses who typically worked in the ICU ward, seven female and two male nurses with a mean age of 48 years and mean working experience of 23 years participated in the project, which ran from May 2020 to January 2021. The main reason for the non-participation of nurses was that since this study was conducted during the COVID-19 pandemic, most of the ICU nurses were busy carrying out their specialized duties and challenges during the pandemic. The baseline audit was conducted in May 2020. The audit criteria and methods to measure compliance are listed in Table 1.

Phase 5: Implementation of changes to practice

After conducting the baseline audit and identifying the gaps between current practice and best practice, a multidisciplinary team of intensivists used the GRiP tool to document barriers, strategies, and resources. The team summarized areas of excellent ($>$ 75%), moderate (50%–75%), and low ($<$ 50%) compliance. The GRiP tool was then used to provide a clearly outlined plan to implement the targeted strategies.

Impact evaluation and sustainability

Phase 6: Re-assessment of practice using a follow-up audit

After the implementation of interventional strategies developed in the previous phase, a follow-up audit was conducted using the same audit criteria as in the baseline audit. At this stage, follow-up data on the 13

Table 1: Audit criteria, sample, and approach to the measurement of compliance with best practice

Audit criterion	Sample	Method used to measure compliance
1. Education and training includes time to practice skills.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if the training included time to practice skills. 'NO' was marked if the training did not include time to practice skills.
2. Education and training is tailored to context, audience, participants' prior experience, and practice requirements.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if the training was tailored to context, audience, participants' prior experience and practice requirements. 'NO' was marked if the training was not tailored to context, audience, participants' prior experience and practice requirements.
3. A manikin is used during training.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if a manikin was used during training. 'NO' was marked if a manikin was not used during training.
4. The manikin selected for training has features that align with the learning objectives.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if the manikin device had features that aligned with the learning objectives. 'NO' was marked if the manikin device did not have features that aligned with the learning objectives.
5. Training includes the ability to recognize an emergency, ability to call an emergency response, competence in chest compressions and rescue breathing, use of an automated external defibrillator, and emotional preparation for the capability to act in an emergency.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if the training included the ability to recognize an emergency, ability to call an emergency response, competence in chest compressions and rescue breathing, use of an automated external defibrillator, and emotional preparation for the capability to act in an emergency. 'NO' was marked if the training did not include the ability to recognize an emergency, ability to call an emergency response, competence in chest compressions and rescue breathing, use of an automated external defibrillator, and emotional preparation for the capability to act in an emergency.
6. Feedback and debriefing is incorporated into the training.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if feedback and debriefing was incorporated in the training. 'NO' was marked if feedback and debriefing was not incorporated in the training
7. A cardiopulmonary resuscitation (CPR) feedback device is used in training.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if CPR feedback device was used in training. 'NO' was marked if CPR feedback device was not used in training
8. If CPR feedback devices are unavailable, tonal guidance is provided during training to improve the compression rate.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if tonal guidance during training was provided to improve compression rate. 'NO' was marked if tonal guidance during training was not provided to improve compression rate.
9. Retraining health professionals in basic life support occurs more frequently than yearly.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if retraining health professionals in basic life support occurred more frequently than yearly. 'NO' was marked if retraining health professionals in basic life support did not occur more frequently than yearly.

Table 1: (*Continued*)

Audit criterion	Sample	Method used to measure compliance
10. Training includes an assessment component.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if training included an assessment component. 'NO' was marked if training did not include an assessment component.
11. Assessments are conducted throughout the training.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. They were asked if assessments are conducted throughout the training. 'YES' was marked if assessments were conducted throughout the training. 'NO' was marked if assessments were not conducted throughout the training.
12. Competency to perform CPR is assessed at the end of the training.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if competency to perform CPR was assessed at the end of the training. 'NO' was marked if competency to perform CPR was not assessed at the end of the training.
13. A standardized, valid assessment tool is used.	Baseline: 9 nurses Follow-up: 9 nurses	Information based on interviews with nurses. 'YES' was marked if a standardized, valid assessment tool was used. 'NO' was marked if a standardized, valid assessment tool was not used.

audit criteria were entered into JBI PACES and compared with baseline data to determine any changes in compliance rates.

Phase 7: Considering the sustainability of practice changes

The audit team decided to assess the sustainability of the practice changes in the following order: for criteria achieving $<$ 50% compliance, assessment would be conducted every 3 months; for criteria achieving 50%–75% compliance, assessment would be conducted every 6 months; and for criteria achieving over 75% compliance, assessment would be conducted every 12 months using the same criteria.

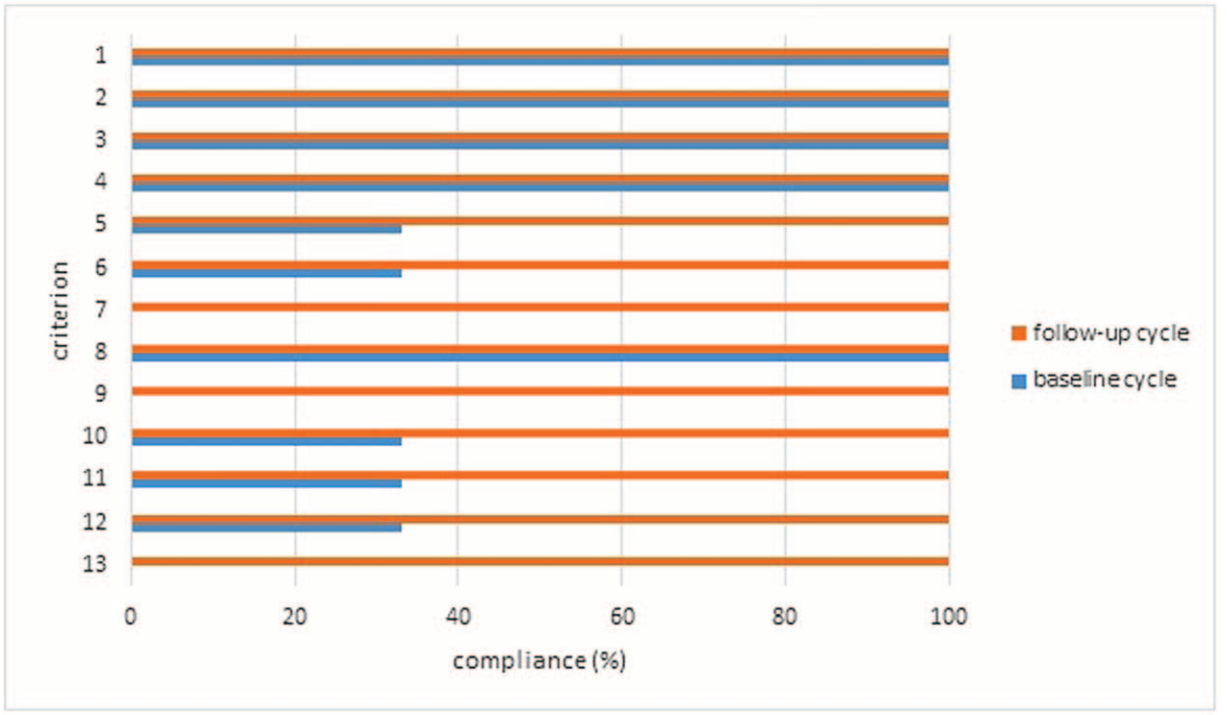
ANALYSIS

JBI PACES, which includes the automated reporting of compliance percentage changes, was used for data analysis. Data on changes in compliance were measured using descriptive statistics embedded in the JBI PACES in the form of percentage changes from baseline.

RESULTS

Baseline audit

The results for each of the 13 criteria are shown in Figure 1 as aggregated baseline data. The results revealed that Criteria 1 to 4 (Education and training includes time to practice skills; Education and training is tailored to context, audience, participants' prior experience and practice requirements; A manikin is used during training; The manikin device has features that align with the learning objectives), and Criterion 8 (If CPR feedback devices are unavailable, tonal guidance is provided during training to improve compression rate) all had 100% compliance. Overall, 8 of the 13 criteria (Feedback and debriefing is incorporated in the training; CPR feedback device is used in training; Retraining health professionals in BLS occurs more frequently than yearly; Training includes an assessment component; Assessments are conducted throughout the training; Competency to perform CPR is assessed at the end of the training; A standardized, valid assessment tool is used) had less than 50% compliance.



Audit criteria

1. Education and training includes time to practice skills. (9 of 9 samples taken)
2. Education and training is tailored to context, audience, participants' prior experience and practice requirements. (9 of 9 samples taken)
3. A manikin is used during training. (9 of 9 samples taken)
4. The manikin has features that align with the learning objectives. (9 of 9 samples taken)
5. Training includes the ability to recognize an emergency, ability to call an emergency response, competence in chest compressions and rescue breathing, use of an automated external defibrillator, and emotional preparation for the capability to act in an emergency. (nine of the nine samples taken)
6. Feedback and debriefing is incorporated in the training. (9 of 9 samples taken)
7. A cardiopulmonary resuscitation (CPR) feedback device is used in training. (9 of 9 samples taken)
8. If CPR feedback devices are unavailable, tonal guidance is provided during training to improve the compression rate. (9 of 9 samples taken)
9. Retraining health professionals in basic life support occurs more frequently than yearly. (9 of 9 samples taken)
10. Training includes an assessment component. (9 of 9 samples taken)
11. Assessments are conducted throughout the training. (9 of 9 samples taken)
12. Competency to perform CPR is assessed at the end of the training. (9 of 9 samples taken)
13. A standardized, valid assessment tool is used. (9 of 9 samples taken)

Figure 1: Compliance with audit criteria at baseline and follow-up (%).

Design and implementation of strategies to improve practice (GRiP)

The results of the GRiP analysis are presented in Table 2. Four main barriers to evidence implementation were identified, and targeted strategies to combat these barriers were formulated.

Barrier 1: Insufficient education tools. There was a lack of educational tools and facilities for nurses in the hospital. To address this barrier, although there was a manikin for BLS training, we realized from informal feedback from nurses that this was not sufficient. Therefore, with support from the research deputy of our hospital, we provided an additional human stimulator manikin. Moreover, educational programs for nurses, including face-to-face and e-learning, were developed. The content included PowerPoint presentations in Persian on best practice recommendations. The results of these educational

Table 2: Getting Research into Practice (GRiP) analysis

Barrier	Strategy	Resources	Outcomes
1. Insufficient education tools and programs.	Providing human stimulator manikin. Providing educational sessions, workshops, and conferences.	Support from research deputy of the hospital. Human stimulator manikin. Educational videos and pamphlets. Slides. Printed materials.	Educational tools and materials were provided (Criteria 5–7).
2. Insufficient supervision.	Establishment of Cardiopulmonary-Cerebral Resuscitation (CPCR) Department in the hospital.	Support of the head of the hospital.	The supervision was improved (Criteria 10–13).
3. Lack of skills laboratory in hospital.	Establishment of a Skills Laboratory in the hospital.	Support of the head of the hospital. Financial resources.	All nurses were systematically trained (Criteria 5–7).
4. Lack of continuous BLS education.	Developing continuous education program based on the American Heart Association guidelines.	Support of the education and research deputy of hospital.	All nurses were systematically and regularly trained (Criterion 9)

programs were assessed using checklists to test the participants' knowledge and learning. The project coordinator designed the training program, engaged team members, and led the workshops.

Barrier 2: Insufficient supervision. Insufficient supervision in the ward resulted in unsuccessful BLS training. To overcome this barrier, we established a Cardio-pulmonary Cerebral Resuscitation Department, with support from the head of the hospital.

Barrier 3: Lack of skills laboratory in hospital. To overcome this barrier, we established a skills laboratory in the hospital for nurses to learn the necessary medical skills with devices simulating the human body. In addition, we provided the necessary tools and facilities for the laboratory.

Barrier 4: Lack of continuous BLS education. There was a lack of continuous BLS education for nurses in the hospital. To address this barrier, we developed a continuous education program based on the American Heart Association guidelines. As a result, all nurses were systematically and regularly trained on BLS.

Follow-up audit

The follow-up audit used the same audit criteria and the same nine nursing staff as in the baseline audit. The results are shown in Figure 1. All criteria improved to 100% after implementing the strategies. Criteria 1–4 and Criterion 8 were already 100% compliant at baseline. Criteria 5, 6, and 10–12 increased from 33% at the baseline to 100% at follow-up. Criteria 7, 9, and 13 increased from 0% at the baseline to 100% at the follow-up. To confirm the sustainability of this evidence implementation project, we plan to re-audit all the criteria after 12 months.

DISCUSSION

This project evaluated current practices and implemented best practices related to BLS training for ICU nurses at a general hospital in Tabriz, Iran. Following a baseline and follow-up audit, the project led to a significant improvement in all 13 criteria. We found that insufficient educational tools and programs were the main barriers to non-compliance. A systematic review on CPR education in Russia reported that education should incorporate a theoretical component, followed by a skills training session, and should be of varied duration; however, there was no clear evidence on how education should be structured. The authors reported a critical need for further high-quality research in this area.[17] Mastery learning (deliberate practice) is associated with improved practice skills and should be incorporated into training, with priority given to behaviors that improve patient safety or clinical outcomes.[18] Experts claim that any attempt at resuscitation is better than no attempt; therefore, assessment of CPR techniques should focus on adequate CPR and not on achieving set figures or rates.[19]

Human simulator manikins were used in this study to improve the quality of BLS training. In similar studies,

manikins were suggested for organizations that have the infrastructure, personnel, and resources to maintain the program, and the device should have physical features that align with the learning objectives.[18,20,21] BLS training should also include the ability to recognize an emergency, ability to call an emergency response, competence in chest compressions, rescue breathing, use of an automated external defibrillator, and emotional preparation for the capability to act in an emergency.[21] Training should incorporate both non-technical (communication skills, team leadership, and team member roles) and technical skills.[21] The optimal timing and duration of training sessions have not been established, and training should be tailored to the context, audience, participants' prior experience, and practice requirements.[18,21] Some evidence suggests that "spaced practice" (training distributed over several discrete sessions over a prolonged period) may improve BLS performance compared with "massed practice" (involving a single period of training without rest over hours/days). Experts recommend replacing or supplementing massed practice with spaced practice.[18] When comparing the method of instructional delivery (self-instruction versus instructor-led), the evidence demonstrates no difference in knowledge and skill at the conclusion of the training session and 1 year post-training. Experts recommend that self-instruction and hands-on practice may be an effective alternative.[20] Technology-enhanced simulators and learning management systems are useful for collecting individual learner data during training to assist in establishing the interval of training required; however, available resources and personnel to support this activity should be considered.[20]

Insufficient supervision was another barrier to compliance with BLS training. A Cardio-pulmonary Cerebral Resuscitation Department was established in the hospital to address this barrier. Feedback and debriefing have been identified as integral to education and should be incorporated into training sessions to provide an opportunity to report data and discuss the participant's performance. Another useful practice is debriefing participants after an actual event.[18] There is no evidence to support the use of CPR feedback devices during real-time CPR; however, they may be considered in BLS training or at a system level to provide quality improvement data and learn CPR skills. The cost-effectiveness of resource allocations should be considered.[20,21] If feedback devices are unavailable, experts suggest using tonal guidance during training to improve the compression rate.[20] There is insufficient evidence regarding the optimal timing and methods for retraining health professionals in BLS; however, evidence suggests that skills decline within 3 to 12 months, and frequent training improves CPR skills.[20] Experts recommend that retraining be conducted more frequently than to once to twice yearly.[20,21]

Although the barriers to implementation were challenging, our project showed improvements for each criterion in the follow-up audit, which were both clinically important and statistically significant. The improvement in all criteria was 100% after the implementation of effective strategies. For example, the provision of standard e-learning education, a validated tool for BLS assessment, and the establishment of a Cardio-pulmonary Cerebral Resuscitation Department and Skills Laboratory in the hospital changed the situation from 0% to 100%. Therefore, improvement in this criterion after the appropriate intervention strategy can be considered more qualitative than quantitative. Regarding the training of nurses, at the beginning of the study, none of the nine trained ICU nurses had a certificate from the training course. Therefore, the training of all nurses led to 100% compliance. The project team will re-audit all criteria after 12 months to gauge the sustainability of the BLS training. We suggest that continuous BLS training should be included in the list of clinical audit criteria for health care providers in this context.

Strengths and limitations of the study

This project addressed an important problem related to BLS training. Despite the success of the project, there were some limitations. The first was the COVID-19 pandemic. The high workload of ICU nurses due to the pandemic may have affected the success rate of strategies; nonetheless, we achieved 100% compliance with all criteria. In addition, owing to time and financial constraints, the strategies were implemented in only one ward and one hospital. Therefore, similarly to most implementation projects, the sample size was small, and may not be generalizable to other hospitals.

CONCLUSION

Implementing a BLS training program for ICU nurses working in a low- to middle-income country such as Iran is necessary. The current implementation project

made a major contribution to establishing evidence-based practices for BLS training. To ensure the sustainability of the best practice recommendations, continuous BLS education for ICU nurses should be systematized. Further research on BLS training should include a priori targeted needs assessment and qualitative studies to assess nursing experiences to better understand how BLS training can be adapted in similar contexts.

CONSENT FOR PUBLICATION

All authors have given consent for publication.

AVAILABILITY OF DATA AND MATERIALS

All relevant data are included in the manuscript. The questionnaires are available upon request.

FUNDING

All funding sources were provided by the project director.

AUTHOR CONTRIBUTIONS

HS led the project and all phases; SH monitored and supervised the project; NK drafted the manuscript; and HS analyzed the data.

ACKNOWLEDGMENTS

The authors acknowledge the dedicated team members involved in this project from the Imam Reza General Hospital, Tabriz, Iran. We appreciate the cooperation of the Clinical Research Development Unit, Imam Reza General Hospital, Tabriz, Iran, for conducting this research.

REFERENCES

1. Afzalzadeh M, Saraj Khorami N, Nazari AA, Lari Najafi M. Effect of training workshop and problem solving methods in training of cardiopulmonary resuscitation (CPR) on nursing and anesthesia students' performance and awareness of Dezful university of medical sciences. Life Sci J 2014;11(9 s):598–607.
2. Soleimanpour M, Rahmani F, Golzari MN, Ala A, Bagi HRM, Esfanjani RM, *et al*. Comparison of electronic learning versus lecture-based learning in improving emergency medicine residents' knowledge about mild induced hypothermia after cardiac arrest. Anesth Pain Med 2017;7 (4).
3. Berger C, Brinkrolf P, Ertmer C, Becker J, Friederichs H, Wenk M, *et al*. Combination of problem-based learning with high-fidelity simulation in CPR training improves short and long-term CPR skills: a randomised single blinded trial. BMC Med Educ 2019;19:1–10.
4. Chan PS, Greif R, Anderson T, Atiq H, Couto TB, Considine J, *et al*. Ten steps toward improving in-hospital cardiac arrest quality of care and outcomes. Circ Cardiovasc Qual Outcomes 2023;16(11):e010491.
5. Guetterman TC, Kellenberg JE, Krein SL, Harrod M, Lehrich JL, Iwashyna TJ, *et al*. Nursing roles for in-hospital cardiac arrest response: higher versus lower performing hospitals. BMJ Qual Saf 2019;28(11):916–24.
6. Vatani J, Javadifar S, Rabori MAS, Khanikosarkhizi Z, Bardsirii TI, Mazloumi E, *et al*. Training needs assessment of intensive care nurses in Zabol University of Medical Sciences' Hospitals. J Educ Health Prom 2021;10:85.
7. Moskowitz A, Berg KM, Cocchi MN, Chase M, Yang JX, Sarge J, *et al*. Cardiac arrest in the intensive care unit: an assessment of preventability. Resuscit 2019;145:15–20.
8. Saghizadeh M, Rahmani A, Ahangharzadeh Rezaie S. Investigation of nurse's knowledge and practice working in CCU wards of Taleghani Hospital of Urmia University of Medical Sciences regarding adult CPR. Nurs Midwif J 2006;4(3):99–103.
9. Taghinejad H, Bastami M, Veisani Y, Bahrami B. Investigating the effects of a training package on the knowledge and performance of nurses working in the intensive care unit about cardiopulmonary. Pakistan J Med Health Sci 2020; 14:1674–7.
10. Nikandish R, Jamshidi H, Musavifard R, Zebardast T, Habibi N. Basic cardiopulmonary resuscitation skills of nurses at a teaching hospital in Southeast Iran in 2006. Resuscit 2007; 73(2):321–2.
11. Jordan Z, Lockwood C, Munn Z, Aromataris E. The updated Joanna Briggs Institute model of evidence-based health care. Int J Evid Based Healthc 2019;17(1):58–71.
12. Jordan Z, Pilla B, Porritt K, Munn Z, Aromataris E, Lockwood C. Turning the flywheel: mobilizing the JBI model of evidence-based health care. JBI Evid Implement 2023;21(1): 96–100.
13. Lizarondo L, McArthur A, Moola S, Albornos-Muñoz L, Badeaux J, Bennett M, *et al*. Facilitation as a component of evidence implementation: a multinational perspective. JBI Evid Implement 2022;20(3):180–8.
14. Porritt K, McArthur A, Lockwood C, Munn Z. JBI Manual for Evidence Implementation. JBI; 2020.
15. Porritt K, McArthur A, Lockwood C, Munn Z. JBI's approach to evidence implementation: a 7-phase process model to support and guide getting evidence into practice. JBI Evid Implement 2023;21(1):3–13.
16. Porritt K. Evidence summary. Basic life support: training requirements for health professionals in the hospital setting. The JBI EBP Database. 2018; JBI20142.

17. Birkun A, Glotov M. Education in cardiopulmonary resuscitation in Russia: a systematic review of the available evidence. World J Emerg Med 2017;8(4):245–52.
18. Cheng A, Nadkarni VM, Mancini MB, Hunt EA, Sinz EH, Merchant RM, *et al*. Resuscitation education science: educational strategies to improve outcomes from cardiac arrest: a scientific statement from the American Heart Association. Circulation 2018;138(6):e82–122.
19. Bhanji F, Donoghue AJ, Wolff MS, Flores GE, Halamek LP, Berman JM, *et al*. Part 14: Education: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation 2015;132(18 Suppl 2):S561–73.
20. Bhanji F, Finn JC, Lockey A, Monsieurs K, Frengley R, Iwami T, *et al*. Part 8: Education, implementation, and teams: 2015 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Circulation 2015;132(16 Suppl 1):S242–68.
21. Greif R, Lockey AS, Conaghan P, Lippert A, De Vries W, Monsieurs KG. European Resuscitation Council guidelines for resuscitation 2015: Section 10. Education and implementation of resuscitation. Resuscit 2015;95:288–301.