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IN-SITU SIMULATION AS A MODERN METHOD OF EDUCATION FOR INTENSIVE CARE UNIT AND EMERGENCY DEPARTMENT NURSES FOR PERFORMING CARDIO-PULMONARY RESUSCITATION

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SUMMARY

Intensive Care Unit (ICU) and Emergency Department (ED) nurses are first in line to recognize and witness a patient's cardiac arrest. They are closer to the patient than the physician or emergency doctor. In addition, ICU and ED nurses are responsible for initiation of cardio-pulmonary resuscitation (CPR) as well as post-cardiac arrest management. The patient's successful recovery after in-hospital cardiac arrest is directly dependent on the nurses' competency. ED and ICU nurses provide care and monitoring for patients in critical condition, which requires sufficient theoretical knowledge, excellent practical skills, awareness of actual modern protocols of emergency conditions, and confidence in their actions. The lack of knowledge and proficient skills among nurses put patients at risk for adverse outcomes. The aim of this literature review is to explore the status of ICU and ED nurses' education in advanced life support (ALS) in worldwide literature in order to determine main trends in improving nurses' ability to perform high-quality CPR. The literature review was conducted through searches from several databases such as CINAHL, PubMed, and Google scholar. 14 peer-reviewed English language articles published between 2012 and 2019 were chosen for the review. As a result of the study, it can be stated that in-situ mock code simulation is a progressive and effective method of education for all health care providers (physicians, nurses, paramedics). Usage of high-fidelity manikins for ALS training is proven to enhance skills performance at course conclusion worldwide. In-situ simulation (ISS) with high-fidelity manikins should be implemented in each medical facility. The training should be conducted according to a comprehensive schedule to increase nurses' confidence and practical skills in CPR.

Key words: *cardiopulmonary resuscitation, high-fidelity simulation, nursing education, mock-code, cardiac arrest, code blue, simulation training.*

Introduction. Sudden cardiac arrest (SCA) is considered as one of the most important and meaningful problems in medicine as it is significant in volume and has economic and social impact [1]. As is known, SCA can be divided into two areas: in-hospital and out-of-hospital. Concerning in-hospital cardiac arrest (CA) only 20 per cent of patients survive while the death-rate is 80 per cent [2]. Cardiac arrest is a life-threatening condition characterized by a total disturbance of blood circulation as result of abrupt cessation of cardiac mechanical function. Specific markers for cardiac arrest include the absence of carotid pulse and the patient gasping or having trouble breathing. It is very important to understand that cardiac arrest is a reversible condition, but only if intervention is performed immediately; if not, it can lead to death [3].

The initial steps of CPR are well known to each Health Care Worker (HCW) and consist of chest compressions and breaths. High-quality CPR increases the possibility of the patient's survival, especially if CPR is performed according to the following instructions: start chest compressions within 10 seconds of the onset of cardiac arrest; deliver appropriate rate of chest compressions, which is about 100 to 120/min; the depth of chest compressions should be five to six centimeters for adults;

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and give two breaths with appropriate volume of air and avoid leaning on the patient's chest, making sure that the patient's chest is rising [4].

There is almost an equal number of cases of in-hospital cardiac arrests (IHCA) and out-of-hospital cardiac arrests (OHCA) and the main reason for both is cardiac in origin [5]. According to the statistics by the American Heart Association (AHA), the total number of OHCA was 366,807 in 2018, which is about 13.5 per cent of all deaths in USA for the same period [6]. In the United States, approximately 209,000 patients experience an in-hospital cardiac arrest (IHCA) each year [7], amounting to an incidence of 3–6 episodes per 1000 hospitalizations [8]. Also, every year, an estimated 359,400 adult patients in the US and 275,000 in Europe are delivered to the emergency department with CA [9].

Regardless of efforts to improve the "chain of survival" procedure, the lack of the victims' recovery after IHCA is still an issue. Only 24 per cent of patients after IHCA are discharged from the medical facility [9,7] and about 14 per cent of them suffer from serious neurological deficiencies [7]. Therefore, the following procedures heavily influence the patient's survival after cardiac arrest: quick diagnostic of CA, instantaneous initial response, and performing high quality CPR [10].

Normally, nurses are the first line of HCWs who encounter IHCA. Moreover, indications to start basic life support (BLS) due to life-threatening conditions are identified by nurses. So, their competence in BLS and ALS is crucial in saving a patient's life. Inefficient primary evaluation, knowledge gaps in protocol of treatment, and inappropriate monitoring of resuscitation lead to unsuccessful CPR results [11]. However, nurses often experience a level of fear of performing CPR and have a hard time remembering protocols and executing the practical skills needed for management of emergency cases [12,18]. To reach increased survival rates, the nursing staff needs to maintain their ability to recognize cardiac arrest sooner, to respond more quickly, and to perform competently during emergencies [13].

The purpose of this literature review is to explore the status of ICU and ED nurses' education in advanced life support in worldwide literature in order to determine main trends in improving nurses' ability to perform high-quality CPR.

Methodology. A literature search was conducted through databases CINAHL, PubMed, and Google Scholar for the following terms: nurse, cardiopulmonary resuscitation, high-fidelity simulation, nursing education, mock-code, cardiac arrest, code blue, resuscitation, and simulation training. All key words were checked from the MeSH database. The publication date was limited to articles published between 2012 and 2019. About 150 articles fitting the search criteria were found. Articles in which authors only briefly mentioned the method of education without explaining it and which were not strictly related with theme were excluded. 14 peer-reviewed full versions of refereed articles in English were chosen for the review. The chosen articles were analyzed with regard to the detailed explanation of the educational intervention and the results and benefits of in-situ simulation and mock-code.

Training courses in a simulation center and the retention of knowledge and skills after the training course.

First, attention should be paid on the retention of practical skills and knowledge of nurses and the schedule of training courses. In the "traditional" education model, healthcare professionals have to pass an exam for BLS certification and then repeat the course every two years to renew the certificate. The certification consists of classroom teaching with a video-based course and a simulation scenario in a simulation center. However, the American Heart Association (AHA) 2015 CPR Guidelines is determined that the two-year pause in training is too long [14]. At present, healthcare workers (HCW) who participate in CPR following cardiac arrest must attend recurring short-interval education courses [15]. Repetitive frequent training in BLS and retraining in ALS may be useful for HCW who are likely to face patients with cardiac arrest [14]. In a mixed-method, explanatory study [16], it was found that the skills learned in CPR training were only sustained for

about two weeks, after which they started to progressively deteriorate, with significant deterioration of these skills revealed six months after training. However, two Swedish hospitals conducted a study on the effect of CPR and automated external defibrillator (AED) training on the self-perceived attitudes of health-care professionals towards performing resuscitation. The results showed that HCW, particularly nurses, were able to improve their attitudes toward CPR and increase their level of knowledge after the training [17].

Several weaknesses have been recognized in the classical system of education for HCW. Comparing the time period of the deterioration of Advanced Cardiovascular Life Support (ACLS) skills and BLS skills is revealed that ACLS skills are lost faster. Moreover, a traditional BLS/ACLS class does not compare to a real emergency in a medical facility [18]. Indeed, Curran, Fleet and Greene [16] state that the active participation in BLS/ACL courses does not assure that HCW will be able to remember course content and use it successfully when faced with a real life-threatening situation. However, Kim et al [19] state that a simulation-based learning method plays a significant role in teaching nurses motor skills. Therefore, a suitable type of simulation training should be chosen in order to reach the educational aims and outcomes. Nevertheless, nurses who do not encounter a cardiac arrest every day would be able to change their attitude to CPR, decrease their fears and increase their confidence through participation in a training simulation. Permanent repetitive learning programs can lead to a positive change in healthcare workers' attitudes toward BLS. Moreover, a correlation has been found between healthcare workers' participation in previous BLS courses and their attitude and level of concern towards CPR. More specifically, the most experienced HCWs have more positive attitudes and not as much concern towards CPR and AEDs than HCWs with less experience [20]. Therefore, the maintenance of HCWs competence in CPR and ALS is a continuous process that requires an appropriate level of education and that is not limited to classroom teaching. Furthermore, it is preferable that nurses take part in simulation more frequently than once in every two years. Indeed, Lund-Kordahl et al. [21] found that high quality of CPR is directly dependent on BLS course degree. The study also reported that the most critical components of CPR, such as ventilations and hands-on time, were also the most dependent by the level of preparedness resulting from training.

As demonstrated by these examples, BLS training and refreshing of skills and knowledge is crucial for increasing the HCWs confidence and ability to perform CPR when needed. Moreover, not only medical professionals should be involved in the continuous education process - the administration should have an interest as well [20].

Recurrent BLS courses are also strongly recommended for increasing the quality and time of initial response and the preparedness for emergencies in the workplace, in other words, to increase nurses' ability to perform high-quality CPR in critical situations. Furthermore, they give a chance to increase positive outcomes after cardiac arrest as well as encourage inter-professional collaboration in healthcare facilities [22]. The study of Vural et al. [23] found that CPR skills should be improved through special training programs at regular intervals. In addition, nurses' knowledge and competence should be re-evaluated regularly according to the actual resuscitation guidelines.

In-situ simulation training's role in modern education of healthcare providers.

In situ simulation (ISS) is a modern method of educating ED and ICU nurses in their workplace. ISS has become the most requested method. As far as nurses encounter emergency cases daily, ISS could bring a positive impact on patient safety through the development of nurses' basic skills and help improve communication and teamwork among HCW [24]. ISS is a developing teaching strategy focused on improving professionals' competencies and interdisciplinary interaction practice in order to improve patient safety. Furthermore, ISS is simulation that is provided in a real clinical environment and

where involved participants are on-duty in their workplaces during simulation [25]. Therefore, one of the main benefits of ISS training is a realistic and interactive training environment. Participants have a chance to develop their critical thinking and reflect on the location of emergency medical equipment and availability of necessary resources [12]. Usually, simulation training activities depend on the level of fidelity of the manikin [26].

The high-fidelity clinical scenarios, based on ISS in nursing, can educate newcomers as well as experienced nurses by supporting them in developing effective communication and collaboration skills, training them in emergency cases, and providing them with a variety of real life-threatening conditions through simulations [19]. For most HCW who attend CPR courses, cardiac arrests and resuscitations are not part of their daily work. Therefore, simulation scenarios have become an important component of nurses' training concerning preparedness and performance in real life emergencies [27].

Some studies have made recommendations for the appropriate schedule (frequency, length, and time) and agenda for ISS. Initial findings of Delac et al. [12] revealed that in-situ medical emergency team/code simulation followed by debriefing improved the performance of responders. After Five Alive course, where 250 nurses participated, the hospital offers four 1–hour sessions every month, which has been found an effective training tool. It has been found challenging to offer the program during the off-shift and weekends, when HCW would be better focused on their performance and tasks in the simulation [12].

Mock-code programs' added value for continuous education in the workplace for nurses' skill retention and preparedness for emergencies.

When examining the influence and benefits of using mock-code or code blue in the workplace, several success factors can be recognized. According to Herbers and Heaser [28], in-situ simulation (mock-code) is one of the most applicable modern methods of education for nursing staff. It can help to achieve good results by hands-on practice for the improvement of nurses' muscle memory and to let HCWs develop and fix their skills in team player roles. Moreover, a repetitive mock-code in the workplace can improve the time of initial response during cardiac arrest and lead to an increased level of confidence among HCWs in emergency situations. According to Reece et al., [29] the mock-code scores were meaningfully higher if participants attended the simulation during day-time and by nurses who had been more confident in their CPR skills.

An implementation of an in-situ mock-code program in medical facilities has given a chance for effective collaboration between other units and allowed medical staff to recognize mistakes and evaluate their experience and personal value as well as the importance of participation. The result of the study Roth, Parfitt, & Brewer [30] implicates that in-situ mock-code is an actual and resultative method of permanent self-development, increasing of self-confidence, self-satisfaction, and education for nursing staff. In-situ mock-codes are a better solution for team work improvement and possibility for HCW to conduct hands on training in short-time period [29]. However, nurses frequently had concerns and their roles were not clear for them during emergency situations. In a study by Hunziker, Pagani, & Fasler [31], initial response was delayed because nurses were confused and expected the physician's instructions.

The mock-code (code blue) programs are typically used for ISS training. Normally the mock-code session is delivered in a realistic training environment, for example, in different places of medical facilities such as the washroom, waiting room, or patient room [9,17]. Thus, nurses are able to significantly improve their level of confidence and practical skills through mock-code simulation [18,12]. Two approaches have been explored in mock-code research: whether conducting mock-code without preliminary training intervention [16,18], or after preparatory training intervention before mock-code. Both improved performance during resuscitation [30,33]. In general, medical facilities where patients

stay for shorter periods had more experienced nurses who also received higher mock-code scores during simulation than other nurses. In both studies specific improvements were found, such as an increase in the level of HCWs confidence or quality of performance during mock-code, for example, reduction in the time of initial chest compression [16,18]. In a quasi-experimental study by Huseman [18], nurses were educated through simulation of cardiac arrest. Mock-code training had been provided for three months and two important things were achieved: HCWs first chest compression was 25 per cent quicker ($t(27)=2.8$, $p=0.0079$) and epinephrine was administered 23 per cent quicker than before ($t(27)=4.6$, $p<0.0001$). Thus, it can be concluded that in situ-mock codes significantly improve response times and increase staff confidence levels. Furthermore, Shehata [22] has provided data proving the efficacy of in-situ simulation for nurses. Therefore, medical facilities may consult this data to make essential changes in their internal CPR policies.

Conclusions. The loss of professional skills such as performing high-quality CPR or recognizing the signs of cardiac arrest could be due to the reduction in the level of nurses' knowledge over time. Retention of knowledge and skills and the level of nurses' confidence are dependent on the frequency of patient emergency cases in medical facilities.

In-situ simulation and use of mock-codes could significantly improve the current quality of life-support skills among nurses and have an influence on patient outcomes after in-hospital cardiac arrest. Annual assessments of nurses' resuscitation skills are not enough to guarantee the quality of knowledge and skills.

The implementation of repetitive in-situ simulations can reduce nurses' stress levels during emergencies, help improve and maintain their CPR knowledge and skills at the appropriate level, and increase their positive attitude towards CPR and emergency situations.

The schedule for mock-codes or in-situ simulations at medical facilities should cover the period of "retention of knowledge"; the interval should be at minimum once in every three months and at maximum once in every two weeks. ISS should be conducted during daytime for nurses who are having a day-off.

The evaluation of nurses' knowledge and skills should be conducted according to the current actual CPR guidelines. Healthcare workers should also conduct a self-assessment, as it is a good tool for permanent self-development and self-improvement. For better results and a positive dynamic after the ISS mock-code implementation, medical professionals and administration as well as managers of medical facilities should be equally involved in the process.

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ТҮЙІНДІ

Медбикелер реанимация және қарқынды терапия (РҚТБ) және Қабылдау Бөлімшесі (ҚБ) – бұл бірінші желісі медицина қызметкерлерінің ғана емес, тап тоқтап, жүрек қызметінің пациент емес, диагностируют. Медбикелер дәрігерге қарағанда пациентке әлдеқайда жақын. Барлығына қосымша РҚТБ және ҚБ мейіргерлері жүрек-өкпе реанимациясының (ЖӨР) бастамашылығына, сондай-ақ, пациентті пост-реанимациялық кезеңде жүргізуге жауапты. Емдеу мекемесінде (ЕМ) жүрек қызметі тоқтағаннан кейін пациенттің денсаулығын сәтті қалпына келтіру мейірбикелердің құзыреттілік деңгейіне тікелей байланысты. РҚТБ және ҚБ медициналық бикелері өте қиын жағдайдағы пациенттерді күтуді және бақылауды жүзеге асырады, ол жеткілікті білім деңгейін, жоғары практикалық дағдыларды, шұғыл көмектің қазіргі заманғы хаттамалары саласында жақсы хабардарлықты және өз іс-қимылдарына сенімді болуды талап етеді. Мейірбикелер арасындағы білім мен тәжірибе деңгейінің төмендігі пациентті емдеудің қолайсыз нәтижесіне ұшыратады. Әдеби шолудың мақсаты әлемдік әдебиет мәліметтері бойынша медициналық бикелердің жоғары сапалы орындау қабілетін жақсартудағы негізгі трендтерді анықтау үшін өмір тіршілігін қолдаудың кеңейтілген курсы саласындағы мейірбикелердің ағымдағы білім мәртебесін зерттеу болып табыла-

ды. Әдеби шолу CINAHL, PubMed, and Google scholar сияқты деректер базасында іздеу арқылы жүргізілді. Талдау үшін ағылшын тілінде 14 мақала таңдап алынды, соның ішінде зерттеу шолулары бар және 2012 жылдан бастап 2019 жылға дейін жарияланған. Зерттеу нәтижесінде «in-situ lock code» жұмыс орнындағы симуляциялық сценарийлер - бұл медицина қызметкерлеріне (дәрігерлер, медбикелер, фельдшерлер) арналған Оқытудың прогрессивті және тиімді әдісі екендігі анықталды. Жоғары шынайы манекендерді өмірлік қамтамасыз етуді қолдаудың кеңейтілген курсы бойынша тренинг кезінде пайдалану курс кезінде практикалық дағдыларды күшейтуді барлық жерде дәлелдеді. Жоғары шынайы манекендері бар жұмыс орнында симуляциялық оқыту әрбір медициналық мекемеде енгізілуі тиіс. Мұндай тренинг ЖӨР орындау кезінде мейірбикелердің өзіне сенімділік деңгейін және практикалық дағдыларын арттыру үшін жасалған оқыту кестесіне сәйкес жүйелі түрде жүргізілуі тиіс.

Кілт сөздер: *жүрек-өкпе реанимациясы, жоғары реалистік симуляция, медбике білімі, жалған код, жүрек қызметінің тоқтауы, көк код, симуляциялық тренинг.*

АННОТАЦИЯ

Медицинские сестры Отделения реанимации (ОРИТ) и Приемного Отделение (ПО) – это первая линия медицинских работников, которые не только сталкиваются с остановкой сердечной деятельности пациента, но и диагностируют ее. Медицинские сестры гораздо ближе к пациенту, нежели доктора. В дополнении ко всему, медицинские сестры ПО и ОРИТ ответственны за инициацию сердечно-легочной реанимации (СЛР); а также, за ведение пациента в пост-реанимационном периоде. Успешное восстановление здоровья пациента после остановки сердечной деятельности в лечебном учреждении (ЛПУ) напрямую зависит от уровня компетенции медицинских сестер. Медицинснкие сестры ОРИТ и ПО осуществляют уход и наблюдение за пациентами, находящимися в критическом состоянии, которое требует достаточного уровня знаний, превосходных практических навыков, хорошей осведомленности в области современных протоколов неотложной помощи и уверенности в собственных действиях. Низкий уровень знаний и опыта среди медицинских сестер подвергает пациента риску неблагоприятного исхода лечения. Целью литературного обзора является исследование текущего статуса образования медицинских сестер в области Расширенного курса поддержания жизнеобеспечения по данным Мировой литературы для того, чтобы определить основные тренды в улучшении способности медицинских сестер выполнять высококачественную СЛР. Литературный обзор был проведен путем поиска в таких базах, данных, как CINAHL, PubMed, and Google scholar. Для анализа было выбрано 14 статей на английском языке, включающие в себя обзоры исследований, и опубликованные в период с 2012 по 2019 годы. В результате исследования было определено, что симуляционные сценарии на рабочем месте «in-situ mock code» - это прогрессивный и эффективный метод обучения для медицинских работников (докторов, медицинских сестер, фельдшеров). Использование высоко-реалистичных манекенов во время тренинга по Расширенному курсу поддержания жизнеобеспечения повсеместно доказало усиление практических навыков во время курса. Симуляционное обучение на рабочем месте с высоко-реалистичными манекенами должно быть внедрено в каждом медицинском учреждении. Подобный тренинг должен проводиться систематически, в соответствии с составленным графиком обучения для увеличения уровня уверенности в себе и практических навыков медицинских сестер во время выполнения СЛР.

Ключевые слова: *сердечно-легочная реанимация, высоко-реалистичная симуляция, медсестринское образование, фиктивный код, остановка сердечной деятельности, код синий, симуляционный тренинг.*