

Developing, Implementation and Evaluation of Patient Safety Training Program for Nurses

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Abstract

Background: Complex medical condition, monitoring, treatment process and multitude devices in Intensive Care Unit (ICU) increase the risk of errors and unintended adverse events. So, Patient safety is important for ICUs nurses.

Aim: The present study was performed with aim to develop, implement and evaluate patient safety training program for nurses.

Method: This semi-experimental study with pretest and posttest design was conducted on 162 nurses recruited from the ICUs in three educational hospitals of Kermanshah University of Medical Sciences. To develop the program, the nurses' needs were assessed using a patient safety questionnaire (84 items) developed based on WHO guideline on nine patient safety statement. After confirming validity and reliability, the questionnaires were distributed among nurses in rotation shifts and retrieved in the same shifts. After developing and implementing the program based on Kern's model, nurses' knowledge and performance in patient safety measures was re-examined. The data were analyzed by SPSS (version 21) and independent and paired t-tests.

Results: The mean score of patient safety knowledge of ICU nurses significantly increased from 51.48 ± 34.35 before the intervention to 57.29 ± 24.17 after the intervention ($p < 0.001$). Also, the mean score of performance significantly increased from 42.53 ± 30.64 before the intervention to 48.91 ± 22.15 after the intervention ($p < 0.001$).

Implications for Practice: The implementation of the patient safety education program for ICU nurses was effective in improving their knowledge and performance of patient safety measures. So, the interventions based on educational model can provide the effective program according to time and cost.

Keywords: Education program, Intensive Care Unit, Nurse, Patient safety

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Introduction

“Patient Safety” refers to the prevention of harm, injury, and adverse effects to patients due to error or inadequacy in care process (1). Annually, millions of patients around the world suffer from life-threatening adverse effects of unsafe care (2). Patient safety evaluations enable healthcare institutions to identify their strengths and weaknesses and get a realistic assessment of the quality of care provided in their units. Patient safety is an especially important issue for Intensive Care Units (ICUs), where patients have complex clinical conditions and receive a wide variety of treatments with a multitude of devices and equipment, and it is therefore a greater potential for error and unintended adverse events (3,4). In a study by Molina et al. (2018) in a 12-bed ICU, they recorded 178 adverse events in 48 patients with an incidence rate of 52.1% (four events per patient on average), 48.9% of which could have been prevented with appropriate patient safety practices (5). In some countries like Iran, workload exceeds that of the number of workforces. Indeed, nurses are not motivated enough to work properly, being horribly perilous that can cause numerous problems at work which may endanger the health of patients (6). In addition, nurses as crucial members of the healthcare team have the primary responsibility for maintaining patient safety. Despite the importance of this issue, in a study conducted by Bayatmanesh et al. (2017) in Iran, ICUs scored 53.43 out of 100 (poor) in the researcher-made checklist of the compliance of nursing care with patient safety standards (1).

Since a primary cause of nursing errors in ICUs is inadequate knowledge due to poor training, an educational program for nurses may be a good solution for improving patient safety in these units (7). Nurses’ intervention, both directly and indirectly, plays a crucial role in the treatment process. In addition, rapid changes in technology highlight the important role of nurses. Nurses should be always up to date and learn how can utilize new devices to reduce the risk of errors (8). Personnel’s skill in transmitting information can influence more on safety process. Clinical information related to patients should be carefully transferred. To reach this goal, a well-organized program should be considered to increase the knowledge of nurses not only in communication but also in transferring new data to provide a safe condition (9). The first step of developing an educational program is to assess the nursing needs. An educational needs assessment highlights the deficiencies in the skills, knowledge, and abilities that people need to accomplish their tasks, thereby showing the direction that an education program must follow to achieve its objectives (10).

One way to develop educational programs for medical settings is to use Kern’s educational model. First introduced in 1998, this model consists of six steps: 1- problem identification and general needs assessment, 2- targeted needs assessment, 3- determination of goals and objectives, 4- formulation of educational strategies, 5- implementation of the program, and 6- evaluation and feedback (11, 12). Robertson et al. (2019) used this model to develop 66 patient care educational programs for American anesthesia residents, of which 91% were able to prepare the residents for participating in the American Board of Anesthesiology’s exam (13). Several studies have shown the effectiveness of education and empowerment programs in improving patient safety culture among nurses. For example, in a study by Xie et al. (2017), an educational program was conducted for 83 head nurses, of whom 67 cooperated until the end of the study (80.72%), the results showed an improvement in patient safety culture, in which led to the satisfaction of 98.01% of head-nurses with the effect (14). Literature search showed that no study has been conducted on the development and implementation of patient safety educational program for ICU nurses. Furthermore, the researchers’ personal experiences have shown that most nurses tend to view patient safety as an issue of minor importance. Also, despite the recommendations of international health institutions, Iran still lacks a patient safety educational program developed based on the needs of ICU nurses. So, this study was performed with aim to develop, implement and evaluate patient safety training program for nurses.

Methods

This semi-experimental study with pretest and posttest design was performed on ICU nurses working in three hospitals affiliated with Kermanshah University of Medical Sciences (Imam Khomeini, Farabi, and Taleghani Hospitals) from March 21 to September 22, 2021. A session was held in the ICU of each hospital and the objectives of the research were presented and all the nurses were eager to participate in the research. Since the nurses in these three hospitals were interacting with each other, census sampling was carried out. The qualified nurses in three hospitals enrolled in the study and the importance of patient safety was emphasized by the educational supervisor. The reason for

choosing three centers was the variety of patients admitted in three hospitals, which increased generalizability. Initially, 188 nurses were selected, but eventually decreased to 162 due to the exclusion criteria. The inclusion criteria were having a rotating shift, having a bachelor's or higher degree, and at least 6 months' experience of working in ICUs. The participants were recruited by the researchers in daily visits (in the morning, evening, and night shifts) to the hospitals' ICUs. The nurses with less than 6-month experience, high work load, and those who did not want to cooperate were excluded from the study.

Data collection tools in this study were demographic information questionnaire and patient safety checklist. The demographic information questionnaire was a researcher-made questionnaire that collects the personal information of nurses, including age, sex, marital status, education level, clinical work experience, work experience in the intensive care unit, and interest in working in the intensive care unit. Also, patient safety questionnaire collects nurses' knowledge of patient safety training courses held in the hospital and history of participation in these courses and interest in participating in these courses. The patient safety checklist was the checklist provided in a semi-experimental study by Ghanbari et al. (2019). They established the validity of this tool by the confirmation of five faculty members of Guilan University of Medical Sciences after applying their suggested adjustments and modifications, and established the reliability of the tool with a Cronbach's alpha of $\alpha=0.83$ (15). In the present study, after minor modifications in the phrasing of the questions as recommended by six professors of Shahid Beheshti University of Medical Sciences (Tehran) and four ICU head nurses of Modares Hospital (Tehran), the validity of the questionnaire was reconfirmed and its reliability was re-verified with Cronbach's alpha of 0.84 in a pilot study with 20 participants. This tool consists of 84 statements based on WHO guidelines on the nine patient safety solutions: 1. Policy and practice regarding medication names (7 statements), 2. Policy and practice regarding patient identification (13 statements), 3. Policy and practice regarding communication during patient handovers (14 statements), 4. Policy and practice regarding performing proper procedure at correct body site (8 statements), 5. Policy and practice regarding controlling concentrated electrolyte solutions (8 statements), 6. Policy and practice regarding ensuring medication accuracy during transitions in care (3 statements), 7. Policy and practice regarding avoiding catheter and tubing miss-connections (2 statements), 8. Policy and practice regarding single-use devices (18 statements), and 9. Policy and practice regarding hand hygiene (14 statements). One section of this checklist is devoted to evaluate how much these nine solutions are used in practice with the following responses: 1) I have done that (2 points), 2) I have not done that (1 point), 3) I have not seen that (0 points). Another section of the checklist evaluates how much nurses are aware of these nine solutions with the following responses: 1) I knew that (2 points), 2) I did not know that (1 point), and 3) I have not encountered that (0 points). In order to ensure proper data collection from the entire population, the researchers attended the hospitals during the nurses' shifts (morning, evening, and night) and remained present while nurses were filling out the questionnaire and checklist. After data collection, sessions were held in the stations of ICU wards during different shifts and the educational needs assessment of nurses continued as instructed in Kern's model based on WHO's nine patient safety educational program. Six steps of Kern's model are as follows:

1-Problem Identification and General Needs Assessment

The researcher attended the selected hospitals of Kermanshah University of Medical Sciences (Imam Khomeini, Farabi, Taleghani) and followed the ethical considerations and explained the purpose of the research for the studied samples and also ensured them about the anonymity and confidentiality of information. After taking informed oral consent and away from any coercion, the study tools, including demographic information questionnaire and checklist of nine patient safety solutions were provided to the participants. The average time to complete the questionnaires was about 15-20 minutes by each person, and in order to study the entire population based on the nurses' shift schedule (morning, evening and night), the researcher was present in the research environment and the questionnaire and the checklist were completed in the presence of the researcher during the rest time of the personnel during the shift. Due to the restrictions during the spread of the corona disease, it took about a year to complete all the questionnaires. Also, the colleagues who were trusted by the researcher in the ICU helped to distribute and collect the questionnaires in all three rotating shifts, so that some of the questionnaires were completed in their presence. At the beginning of the shift, the goals of the program were explained and the nurses were assured that the extracted information will

be used to improve the patient's safety and each person should complete the questionnaire independently and with his own point of view. The contact number of the researcher was also available for them to call in case of any questions.

2-Targeted Needs Assessment

Based on the obtained information, the educational needs assessment of nurses continued according to the second stage of Kern's model in order to design and compile an educational program. In other words, in each part of the questionnaires where more weakness was observed, more educational contents were considered to improve the knowledge and performance of nurses.

3-Goals and Objectives

The third step was the determination of goals and objectives. This research was carried out with aim to develop, implement and evaluate the patient safety training program for nurses working in ICU based on the needs assessment of the previous step.

4-Educational Strategies

The fourth step was the determination of educational solutions. According to the studies conducted and the solutions and conclusions presented, in order to obtain the best possible results, it was tried to start from a simple rest room such as the nurses' rest room or the nursing station. For face-to-face meetings and lectures, the equipment and drugs available in the department are considered for greater impact and realization of the situation. The topics taught on the World Health Organization's website were downloaded and translated into Persian, and for the validity of the content, it was given to five nursing professors and three hospital educational supervisors, and finally, after reviewing the abstract of the practical content, it was given in the form of a pamphlet with the number of nurses participated. Also, the important contents and headlines were prepared in the form of posters for the number of departments, which should be installed in a place that has the greatest psychological impact with the guidance of the supervisors of the studied departments. In order to master the studied materials and gain the trust of the nurses, the researcher reviewed as many materials as possible to prepare for lectures and questions and answers like an expert trainer in the educational environment.

5-Implementation

In the fifth step, which was the implementation of the program, according to the solutions from the fourth step, the educational program was implemented in the form of a workshop by lectures and role-playing as needed, for a total of 4 hours per day, based on the shift schedule of nurses in ICU. The program was held on different days and many times so that all nurses could participate. In this way, in each shift, with the permission of the shift manager, the nurses gathered at the nursing station and were trained. In general, the program took 3 to 4 months. Each training session lasted about half to 45 minutes depending on the workload of the nurses in the desired shift and their rest time. To maximize the training effect, for example, some drugs in the resuscitation trolley that required a yellow or red label were labeled as evidence in the presence of personnel. Equipment such as Foley catheters or gastric catheters with all sizes and expiration dates were displayed in the presence of nurses. Proper washing of hands was done in their presence. The correct way of scrubbing the hands was done. The correct use of sterile equipment and keeping it sterile during use and installation was done, for example, wearing sterile gloves and opening sterile syringes and other equipment. Similar drugs such as dexamethasone and furosemide were indicated. A suitable identification bracelet that was pre-printed and intended for training was displayed with all the specifications and their appropriate color scheme. The cases were reviewed in the presence of nurses and the shortcomings and positive points were explained. The correct way for taking medicine and use vials was practiced. Other theory materials such as Harden and Ronald were explained and taught according to the information obtained from the WHO website. In addition, educational pamphlets were given to all participants at the end of the meeting, and educational content was installed in the form of posters in the departments. Posters are usually placed in the nursing station with the right size and colors to have the most impact when the nurses are resting in the station and motivate them to read the material. In order to ensure the participation of all nurses in the training program for three months, the researcher was diligent in all shifts, and in case of questions, she reviewed the answers and posters with the nurses. Also, the researcher tried to ask all the nurses about the program and the posters installed to ensure learning.

6-Evaluation and Feedback

For evaluation and feedback in the last stage after one month, the researcher visited the department in different shifts and evaluated the nurses' knowledge and performance using the checklist of nine

patient safety solutions. After collecting the data, the level of knowledge and performance of ICU nurses on nine patient safety solutions was evaluated using SPSS software (version 19) and paired t-tests. The results were independently checked and compare with the results before the study. The results of this research showed that "developing, implementing and evaluating the patient safety training program for nurses in special care units is effective on the level of knowledge about the patient safety policy and all its dimensions, as well as safe performance and all its dimensions". This finding indicates that more comprehensive guidelines should be developed based on the nurses' needs and be taught periodically in different ways, so that steps can be taken to improve the knowledge and performance of nurses. Hospitals are considered to be safety-friendly when they can have an acceptable score in safe performance. This point becomes more important in ICU wards due to special conditions, the lack of patients' consciousness, as well as the use of devices and equipment. The data were analyzed using SPSS software (version 21). Descriptive statistics were used to determine the quantitative variables and draw the graphs and tables describing the data. The scores gained from the responses were analyzed with the Wilcoxon test. $p < 0.05$ was considered statistically significant.

Results

A total of 162 nurses participated in the study. The mean age of the participating nurses was 31.96 ± 6.25 years. The mean of nurses' work experience was 7.04 ± 5.82 years with mean work experience of 4.36 ± 4.81 years in ICU. Other demographic characteristics of nurses were presented in Table 1.

Table 1. Distribution of demographic characteristics of the participating nurses

Variable	N (%)
Gender	
Male	54 (33.3)
Female	108 (66.7)
Marital status	
Single	76 (46.9)
Married	86 (53.1)
Education level	
Bachelor	154 (95.1)
Master and above	8 (4.9)
Hospital	
Taleghani	85 (52.5)
Farabi	49 (30.2)
Imam Khomeini	28 (17.3)
Interested in working in ICU	
Yes	122 (75.3)
No	11 (6.8)
No difference	29 (17.9)
Previously participated in a patient safety education course	
Yes	131 (80.9)
No	31 (19.1)
Interested in participating in the patient safety education course	
Yes	91 (56.2)
No	50 (30.9)
No difference	21 (13)

Results are reported based on nine patient safety solutions. The mean score of the nurses' knowledge of policy on medication names significantly increased from 5.27 ± 3.09 before the intervention to 5.35 ± 2.92 after the intervention ($p=0.014$). The scores for the nurses' knowledge of other policies and their total patient safety policy knowledge score also significantly changed after the intervention compared to before the intervention ($p<0.05$) (Table 2).

Table 2. Nurses' knowledge scores for individual patient safety policies and their total patient safety policy awareness scores before and after the intervention

Stage	Pre-intervention	Post-intervention	Wilcoxon test results	
Variable	Mean±SD	Mean±SD	P-value	Statistic
Medication names	5.27±3.09	5.35±2.92	0.014	2.44
Patient identification	6.24±6.50	6.93±5.89	<0.001	5.29
Communication during patient handovers	7.58±7.41	8.32±6.22	<0.001	4.93
Performing correct procedure at correct body site	4.84±3.63	5.23±2.84	<0.001	3.85
Controlling concentrated electrolyte solutions	4.66±4.31	5.36±3.32	<0.001	4.54
Ensuring medication accuracy during transitions in care	0.70±2.28	0.95±2.14	0.001	3.40
Avoiding catheter and tubing miss-connections	1.39±1.19	1.60±0.98	0.001	3.31
Single-use devices	10.96±7.61	12.36±5.01	<0.001	5.06
Hand hygiene	9.80±6.82	11.15±4.57	<0.001	4.64
Total patient safety policy awareness	51.48±34.35	57.29±24.17	<0.001	7.43

The Mean score of the nurses' performance regarding medication names significantly increased from 3.56 ± 3.0 before the intervention to 4.16 ± 2.47 after the intervention ($p<0.05$). The nurses' performance scores for other patient safety practices and their total patient safety performance score also significantly increased after the intervention compared to before the intervention ($p<0.05$) (Table 3).

Table 3. Nurses' performance scores for individual patient safety practices and their total patient safety performance scores before and after the intervention

Stage	Pre-intervention	Post-intervention	Wilcoxon results	test
Variable	Mean±SD	Mean±SD	P-value	Statistic
Medication names	3.56±3.0	4.16±2.47	<0.001	-4.52
Patient identification	4.11±5.73	5.21±4.55	<0.001	-3.61
Communication during patient handovers	7.34±6.79	8.25±5.90	<0.001	-5.51
Performing correct procedure at correct body site	4.51±3.47	4.74±3.23	<0.001	-3.70
Controlling concentrated electrolyte solutions	4.56±3.56	4.90±3.20	<0.001	-4.08
Ensuring medication accuracy during transitions in care	0.32±2.09	0.98±1.86	<0.001	-5.73
Avoiding catheter and tubing miss-connections	0.64±1.61	1.02±1.37	<0.001	-5.56
Single-use devices	8.91±7.89	10.10±6.28	<0.001	-4.96
Hand hygiene	8.55±6.76	9.97±5.14	<0.001	-5.09
Total patient safety performance	42.53±30.64	48.91±22.15	<0.001	-6.75

Discussion

The aim of the present study was to develop, implement and evaluate the patient safety training program for ICU nurses. The results of the current study showed that the educational program based on Kern's model can positively affect the patient safety knowledge and performance in ICU nurses. This finding is consistent with the results of the majority of studies conducted in this field. For example, in a study published by Pazokian and Borhani (2017), Iranian nurses usually suffer from lack of a customized education during their studying, which will result in reducing patient safety (6). The study conducted by Shin et al. (2021) in South Korea reported that educational program improved the patient safety knowledge and awareness of caregivers and patients (16). Anugrahsari et al. in their study conducted in Indonesia concluded that educational interventions can be effective in improving the patient safety knowledge and awareness of medical students (17). In a survey by Abdulredha et al. (2023), training program have a positive effect on nurses' performance regarding transfusion of blood and blood product for children, so that training program increased the knowledge of nurses about blood transfusion program and patients' satisfaction (18). In a study by Hemmatipour et al. (2020), they found that education via the WhatsApp social network can improve the knowledge and performance of nursing students (19). Pourteimour and colleagues (2017) investigated the effect of e-learning on the knowledge, attitude, and performance of nursing students in order to prevent medication errors in pediatric wards. They found that e-learning can indeed improve patient safety in these wards by improving the knowledge, attitude, and performance of nursing students regarding medication errors (20). In a study by Aliyari et al. (2016), they reported that evidence-based nursing education was effective in improving multiple aspects of the ICU nurses' awareness of patient safety (21). Hasanbeigi and colleagues (2017) reported that nurses should be always up to date and learn how can utilize new devices to reduce the risk of errors (8). The authors believe that the main reason for this consistency in findings is that educational interventions by nature improve the nurses' knowledge and awareness of the issue, which can be viewed as the first step towards acquiring patient safety skills and respecting patient safety guidelines.

In the present study, after developing the patient safety education program for ICU nurses based on the available resources, its effects on the nurses were investigated. This program included face-to-face and group education in clinical settings, with a brochure of the content provided to participants at the end of the session to help reinforce their learning. The target group of this study was nurses working in ICUs, where patient safety is extremely more important because of the patients' unconsciousness and their special medical conditions and the fact that nurses have to work with a wide variety of medical devices and equipment. According to previous studies in this field, patient safety in its different dimensions can be influenced by various factors, including organizational factors like inefficient policies and poor employee training and education, human factors like poor nurse-nurse and nurse-patient communication, and individual differences of nurses and patients (22). One way to address these issues is to measure how much care providers comply with safety requirements while providing care services and determine how the medical team and especially nurses can improve in this regard (21). This is important because over 90% of errors originate from human factors, and many of these errors can be prevented simply by institutionalizing safe behaviors and establishing and enforcing effective safety rules and regulations in the organization. While some human errors are not completely preventable, it is possible to reduce their frequency by identifying their root causes and adopting appropriate measures to address them (23). A good solution is to give patient safety instructions to healthcare workers, especially nurses, to help them keep up with the advances in the field. Many experts believe that in order to improve the quality and safety of care, in addition to structural interventions, other measures should also be adopted to teach the importance of patient safety to nurses and other medical personnel (24).

The findings of this study regarding the nurses' performance in practicing patient safety measures are also consistent with the reports of the majority of the studies in this area. The results of a study by Torkaman et al. (2022) showed that an educational intervention can improve the patient safety competencies of undergraduate students (25). Rezende et al. (2021) conducted a survey in England titled "Effectiveness of educational interventions to develop patient safety knowledge, skills, behaviors and attitudes in undergraduate nursing students", and they reported that education is among the most effective ways to improve the performance and skills of nursing students in the area of patient safety (26). The study conducted by Shin et al. (2021) in South Korea also reported that

their education program improved the patient safety performance of caregivers (16). Hemmatipour et al. (2019) also investigated the effect of education via social networks on the knowledge and performance of nursing students regarding safe injections. They reported that education via WhatsApp can improve the performance of nursing students (19). In this regard, the study of Pourteimour et al. also showed that e-learning can improve the knowledge, attitude, and performance of nursing students regarding medication errors in pediatric wards, thereby leading to improved patient safety (20).

The authors believe that the consistency in the findings regarding the effect of educational interventions on patient safety performance of nurses can again be attributed to how these interventions improve the nurses' knowledge and awareness of the issue. In other words, while nurses have a theoretical knowledge of the issue, proper education can help them understand the nuances of the issue and why it is important to put their knowledge into practice. A study by Martos-Cabrera et al. (2015) also reported that education by lecture can be effective in improving the performance of nurses in the area of hand hygiene (27). However, the findings of the present study about patient safety are inconsistent with the results of Ghanbari et al. (2019) which found that holding a patient safety workshop was not effective on the performance of nursing students (15). The authors believe that this inconsistency can be related to the contents of workshop and education sessions and how they have been presented, the duration of sessions, and differences in the target group, as the present study attempted to improve the patient safety performance of ICU nurses by developing a program comprised of group sessions in clinical settings.

Implications for practice

The results of this study showed that the patient safety education program developed and implemented for ICUs nurses improved their awareness of patient safety policy in all of its dimensions and also improved their performance in terms of practicing all patient safety measures. The findings highlight the need for more comprehensive instructions developed based on the needs of nurses and taught periodically via different modalities in order to improve their patient safety knowledge, awareness, and performance. Only those hospitals that earn an acceptable patient safety score can be called safety-friendly, and this issue is even more important for ICUs, where safety is crucial because of the patients' unconsciousness and special medical conditions and the fact that nurses have to work with a wide range of medical devices and equipment.

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Conflicts of interest

The authors declared no conflict of interest.

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