



# Clinical Auditing of Patient Safety Standards Before and After Implementation of the Training Program in Intensive Care Units

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## Abstract

**Introduction:** Patient safety is the precious core in the healthcare organizations aimed at minimizing adverse events and eliminating preventable damages. This study aimed at determining the rate of observation of safety standards of ICU patients by nurses before and after implementation of a training program.

**Methods:** This quasi-experimental single-group study was conducted in two phases: observation of nursing performance related to patient safety and the implementation of a corrective training program. In the first phase, 4104 cases of nursing care related to patient safety performed by 54 ICU nurses were observed using chronological sampling. The same samples, i.e., 4104 nursing care performed by the same nurses, were used in the second phase of the study after implementing the training program. The data collection instrument was a valid and reliable researcher-made 76-item questionnaire consisting of 12 categories about nursing care related to patient safety. The corrective training program focused on nursing care related to patient safety. The gleaned data were analyzed with SPSS18 using descriptive statistics and non-parametric Wilcoxon signed-rank tests.

**Results:** The rate of correspondence between nursing care and the checklist was 44.32 % before the intervention, which increased to 95.61% after intervention by a 51.29% increase.

**Conclusions:** Implementation of the corrective intervention effectively promotes patient safety as a training program for nurses. The healthcare system's managers and authorities can reduce the damages sustained by patients and decrease treatment costs by concentrating on periodic supervision and continuous education programs to improve patient safety.

## INTRODUCTION

Special attention has been paid to patient safety since 2000. Recently, The Institute of Medicine has distributed a report focusing on medical errors to promote patient safety in providing health care services. The report states that mistakes serve as a leading cause of mortality and harm to patients. Provision of patient safety functions as one of the main concerns of healthcare professionals. Patient safety is presently rendered as a significant concept and a significant

indicator of controlling the quality of health care services [1]. Today, innovative advancements and healthcare complexity have predisposed to severe defects in patient safety quality and patient safety. The high incidence of clinical risks and safety accidents has elevated healthcare systems' concerns and challenges [2]. Patients in ICUs are mostly exposed to inadvertent incidents due to high complexity in care, underlying diseases, acute conditions, and providing life-sustaining

treatment [3]. Though the magnitude of the problem is speculated imprecisely, millions of people will probably suffer from crippling harms or death as an outcome of clinical risk and safety accidents [2].

Moreover, almost one-tenth of patients sustain harm during healthcare procedures [3]. A recent report by the Institute of Medicine (IOM) indicates that, in the United States, one-third of all hospital patients sustain harm during hospital or ICU stay, leading to more than 400,000 preventable hospital deaths annually. Further, a 5-year study of North Carolina hospitals that could not show improvement in patient safety demonstrated that despite considerable advancements in patient safety interventions, a decrease in patient harm has been intangible. Similarly, the 2010 Office of Inspector General study revealed that 27% of Medicare patients experienced damage or injury during hospitalization [4].

Many patients are exposed to adverse events during their hospital stay. The incidence of various adverse events has been reported by 3-17% in inpatients worldwide. A noticeable proportion of this rate leads to death (%5-21), while more than half of these deaths are preventable [5]. The World Health Organization (WHO) has defined an adverse event as an incident that induces some damage to the patient, such as a wrong diagnosis, wrong treatment, disturbance in the body's functioning and system. Untoward sequelae of the patient's disease may occur in all stages of a care process, from diagnosis to treatment and even during preventive care [6]. The WHO has provided an international standard classification for patient safety with descriptions of the severity of harm, including none (no treatment was required), mild (extra observation, investigation, review or minor treatment, was required), moderate (caused permanent or long-term harm or loss of function), severe (caused significant permanent or long-term damage or loss of process) and death (death was caused) [7].

In the last decade, reducing errors and adverse events has become a significant goal for healthcare institutions. Due to patients' acute conditions in intensive care units, these patients are more likely to be affected than others [8]. Sufficient information on the incidence, causes, and preventability of adverse events should be collected and made available to understand safe hospital care. The standard methods used to analyze unsafe hospital care and improve patient safety include validity measurement, an outsider review using etic perspective, emic perspective auditing, patient safety systems, and performance indices [9]. Auditing is a formal and systematic test of registration, process, structure, environment, or performance assessment estimate. In the healthcare systems, auditing determines the quality of care provided by applying process control for managers. Concurrent or symmetrical auditing is performed while the patient is receiving the care [10]. Internal auditing should be independent and possess

guaranteed confidence, consultation system, early detection of risks of adverse events for patients, and continuously promoting patient safety [11]. Systematic article reviews approve the consequences of auditing and their feedback on healthcare specialists' behavior and the range of patient outcomes (resultants) with a maximal increase of 70% in the professional intervention [12]. Implementing professional interventions in ICUs requires expertise, advanced skills, clinical experiences, problem-solving ability, controlling and persuasive response to critically ill ICU patients [13]. Nurses are the most significant part of health care professionals, giving more than 80% of all care episodes worldwide. Hence, all health professionals should be trained to provide patient-oriented care as interdisciplinary team members, highlighting evidence-based nursing practice and quality improvement approaches [14].

Hence, given the importance of the issue, this study audited the observation of ICU inpatients safety standards clinically, and the results of the training were investigated to correct it. In this study, using auditing stages, the rate of correspondence with and deviation from the nursing care standards related to ICU safety indices were assessed first. Then, the corrective training program was conducted, its efficacy was evaluated, and the results of before and after intervention were analyzed.

This study determined the observation of patient safety standards by nurses before and after corrective training intervention in the ICUs affiliated to Yasooj University of Medical Sciences in Iran from December 2015 to June 2016.

H1: The corrective training intervention exerts an effect on observing the ICU inpatient safety standards.

## METHODS

This quasi-experimental single-group study was conducted in two descriptive and interventional stages covering 12 nursing care categories in three ICUs. First, nurses' present status of the rate of observing patient safety criteria was explored using a descriptive approach. Then, the corrective training program was performed as the intervention. In the next step, the rate of observing patient safety by nurses was investigated again. The population under study included all the nursing care given to ICU inpatients regarding patient safety. Temporal sampling was used in the research's descriptive stage, while the total sample was used in the interventional stage. Having obtained the required permission from the hospital authorities, informed written consent was obtained from each nurse, and the data were collected by the researcher using a checklist and via investigating the nursing care related to patient safety in ICUs. The research setting was three ICUs, including NICU (Neurology Intensive Care Unit) and two general ICUs. Using a checklist, all nursing care given in the 12 mentioned categories were inspected

and assessed meticulously for three weeks before intervention and 3 weeks after intervention in each ward. One of the researchers (the first author) collected the required data via structured observations from the onset of the morning shift to the end of the work shift for three weeks before implementing the training program and for three weeks after implementing the corrective training program. Overall, the caregiving behavior of 54 nurses regarding observation of patient safety was observed for 18 weeks using a researcher-made checklist covering the 12 intended categories. Four thousand one hundred four cases of care-giving were observed and recorded before the intervention, and also 4104 cases of care-giving were inspected and registered after the intervention. Data collection was completed in two-time intervals before and after the training program from December 2015 to June 2016. In the interventional stage, 54 nurses under study participated in 4 one-day training workshops with question-answer sessions and an educational package in the study hospitals.

The observation checklist was a 76-item questionnaire including 12 categories on nursing care related to patient safety in ICUs. These categories were: 1. Admission and initial assessment of the patient (9 items), 2. Paying attention to the drugs with similar names or pronunciations and making sure of the accuracy of the patient's drug therapy (4 items), 3. Performing the right procedure on the right side of the patient's body (10 items), 4. Avoiding the wrong connections of tubings and catheters or trocars (3 items), 5. Patient's gavage (2 items), 6. Preventing patient's falling to the ground (4 items), 7. Preventing formation of emboli and deep vein thrombosis in the patient (7 items), 8. Preventing the formation of bedsores (decubitus ulcers) (4 items), 9. Prevention of nosocomial infections in the patient (7 items), 10. Blood transfusion and prevention of its complications in the patient (11 items), 11. Prevention of surgical complications in the patient (4 items), and 12. They were monitoring the ventilator and the patient's intratracheal tube (11 items). The checklist items were developed to measure nursing care related to patient safety in ICUs in three states of "performed completely=2 points, performed deficiently=1 point, and not performed=0 point".

To determine the qualitative face validity and content validity coefficient of the data collection instrument (checklist) made by the researcher in this study, which was initially 106 words, 13 faculty members of Shahid Beheshti School of Nursing and Midwifery, Tehran and Yasouj School of Nursing and Midwifery, who specialize in management, auditing and care were exceptional, were used. For this purpose, the tool was sent with a letter to researchers and experts who, while explaining the goals and different parts of the device, were asked to study it to see if the phrases in the checklist of the subject under study. Do they measure or not? And to what extent are checklist phrases related to the content and

goals of the project? The validity result is given in the validity calculation section. The CVI index was used (CVI=98%) to calculate the content validity index of the checklist. An inter-observer consistency coefficient was used to establish the instrument's reliability. Two observers completed the lists simultaneously by observing the nursing care given by 10 ICU nurses. The intraclass correlation coefficient was estimated between the two observers' checklists' scores, indicating no statistically significant difference (ICC=%99).

## RESULTS

The culled data were analyzed with both descriptive and analytic statistics (non-parametric Wilcoxon signed-rank tests). The score on each category and the total score estimated by the mean percentage of scores of each type indicate the amount of correspondence of care-giving with the checklist. Table 1 displays the demographic information about 54 nurses employed in ICUs who participated in the training workshop and who were observed.

Considering the amount of correspondence between care-giving and the checklist of patient safety standards before training workshop intervention, given the existence of 76 items, the minimum and maximum scores of the list would be 0 and 152, respectively, with the mean score being converted to percentages which were classified into three ranges: inappropriate (0-50), relatively appropriate (50-75), and reasonable (75-100) (Salwa & Soheir, 2014). The score of each category was estimated based on the items in that category in detail. The obtained scores were subsequently converted to mean percentages, as shown in Table 2. The training program was performed as four one-day workshops focusing on patient safety, with 54 nurses participating in the program to determine the causes of lack of correspondence in each category. Then, the nurses' care-giving behavior with respect to patient safety was carefully observed again after six weeks [15], in the same 12 types using the previous checklist.

**Table 1.** Demographic Information

Background Variable	Frequency (Percentage)
<b>Gender</b>	
Female	74.1 (40)
Male	25.9 (14)
<b>Education level</b>	
BS	90.7 (49)
MSc	9.3 (5)
<b>Age</b>	
21-25	25.9 (14)
26-30	35.2 (19)
31-35	31.5 (17)
36-40	7.4 (4)
<b>Work Experience</b>	
≥3	63 (34)
4-7	20.7 (11)
8-11	9.3 (5)
12-15	3.7 (2)
>15 years	3.7 (2)

**Table 2.** Comparison of the Status of Care-Giving Related to Patient Safety in Before and After Training Program Intervention (Means or Classification)

No.	Category	Mean Before Intervention (%) (Score)	Classification Before Intervention	Mean After Intervention (%) (Score)	Classification After Intervention
1	Admission and initial assessment of the patient	48.9 (8.81)	Inappropriate	89.47 (17)	Appropriate
2	Paying attention to the drugs with similar names or pronunciations and making sure of accuracy of the patient's drug therapy	45.87 (3.67)	Inappropriate	91.37 (7.31)	Appropriate
3	Performing the right procedure on the correct site of the patient's body	34.35 (6.87)	Inappropriate	92.3 (18.46)	Appropriate
4	Avoiding the wrong connections of tubing and catheters or trocars	10.83 (0.65)	Inappropriate	94.83 (5.69)	Appropriate
5	Patient's gavage	64.25 (2.57)	Relatively appropriate	99 (3.96)	Appropriate
6	Preventing patient's falling to the ground	50/25(4/02)	Relatively appropriate	97.87 (7.83)	Appropriate
7	Preventing formation of emboli and venous thrombi in the patient	38.85 (5.44)	Relatively appropriate	96.42 (13.50)	Appropriate
8	Preventing formation of bedsores (decubitus ulcers)	18.75 (0.15)	Relatively appropriate	95.21 (7.61)	Appropriate
9	Prevention of nosocomial infections in the patient	37.57 (5.26)	Relatively appropriate	96.85 (13.56)	Appropriate
10	Blood transfusion and prevention of its complications in the patient	89.54 (19.70)	Appropriate	100 (22)	Appropriate
11	Prevention of surgical complications in the patient	28 (2.24)	Inappropriate	97.62 (7.81)	Appropriate
12	Monitoring the ventilator and the patient's intra tracheal tube	36.27 (7.98)	Inappropriate	93.59 (20.59)	Appropriate
-	Grand total	44.32 (67.37)	Inappropriate	95.61 (145.33)	Appropriate

**Table 3.** Comparison of the Status of Care-Giving Related to Patient Safety in ICUs Before and After Training Program Intervention (Mean  $\pm$ SD)

No.	Category	Negative Rank	Before	Positive Rank	Mean $\pm$ SD After	Z-Test	P-Value
1	Admission and initial assessment of the patient	0.00	8.81 $\pm$ 3.241	27.00	17.00 $\pm$ 1.481	-6.411	0.000
2	Paying attention to the drugs with similar names or pronunciations and making sure of accuracy of the patient's drug therapy	7.75	3.67 $\pm$ 2.198	27.04	7.31 $\pm$ 1.329	-5.873	0.000
3	Performing the right procedure on the correct site	0.00	6.87 $\pm$ 2.795	27.50	18.46 $\pm$ 2.604	-6.402	0.000
4	Avoiding the wrong connections of tubing and catheters or trocars	2.00	0.65 $\pm$ 1.119	27.98	5.69 $\pm$ 0.82	-6.494	0.000
5	Patient's gavage	0.00	2.57 $\pm$ 0.633	26.00	3.96 $\pm$ 0.191	-6.408	0.000
6	Preventing patient's falling to the ground	2.50	4.02 $\pm$ 1.173	27.47	7.83 $\pm$ 0.505	-6.404	0.000
7	Preventing formation of emboli and venous thrombi in the patient	0.00	5.44 $\pm$ 1.766	27.50	13.50 $\pm$ 0.863	-6.429	0.000
8	Preventing formation of bedsores (decubitus ulcers)	0.00	0.15 $\pm$ 0.596	27.50	7.61 $\pm$ 0.998	-6.794	0.000
9	Prevention of nosocomial infections in the patient	0.00	5.26 $\pm$ 2.658	27.50	13.96 $\pm$ 0.816	-6.439	0.000
10	Blood transfusion and prevention of its complications in the patient	0.00	19.70 $\pm$ 1.423	23.50	22.00 $\pm$ 0.00	-5.958	0.000
11	Prevention of surgical complications in the patient	0.00	2.24 $\pm$ 1.080	27.50	7.81 $\pm$ 0.517	-6.479	0.000
12	Monitoring the ventilator and the patient's intra tracheal tube	0.00	7.98 $\pm$ 1.83	27.50	20.59 $\pm$ 1.995	-6.407	0.000
-	Grand total	0.00	5.61 $\pm$ 1.178	27.50	10.55 $\pm$ 0.799	-6.394	0.000

Table 3 demonstrates the rate of correspondence between care-giving and the checklist of patient safety standards after training workshops intervention. Considering the results before and after the intervention, Table 2 presents the change in nurses' behavior in observing patient safety standards.

Nonparametric Wilcoxon signed-rank tests were used to investigate the statistically significant differences between the means of scores obtained from observation of nurses' caregiving behavior before and after the intervention. As revealed in Table 3, the total score of all 12 categories under study and the mean score after intervention were significantly different from the scores

before intervention indicating the efficacy of training program on nurses' caregiving behavior in the study.

### Ethical and Human Considerations

Ethical code was obtained from the Committee of Ethics in Human Research (IR.SBUM.PHNM.180.1394) at Shahid Beheshti University of Medical Sciences to observe the human and ethical considerations. The required permission was also obtained from the hospital authorities. Informed written consent was obtained from each participating nurse, and they were assured of anonymity and confidentiality of information.

### Limitations of the Study

1. The researcher's presence was inevitable due to the auditing nature of the study and observation of behaviors, which might have probably affected the nurses' performance in the study. To remove or reduce this limitation, the researcher (first author) tried her best to eliminate the possible change in behavior by gaining the permission of nurses, through the frequent presence in the morning shifts of the ward and behaving them as a colleague who is after recording observations without referring to any particular individual or hospital. The short time interval after training (six weeks), which occurred due to researcher time limitations, might have influenced the results since permanent behavioral change demands frequent monitoring during more intervals.

### DISCUSSION

Nowadays, health care seems to have become more effective. World Health Organization elucidates patient safety as avoiding errors and adverse effects in patients accompanied by health care [14]. The intensive care unit (ICU) exposes severely ill patients to medical errors more than other patient care areas. To properly address latent and evident patient safety hazards, clinicians and organizations need to be aware of their existence. Among other tools, incident reporting systems have been reported to play a major role in achieving this function [8]. A warranty of patient safety observation in the ICU serves as a key component in the hospital performance. It is considered the crux of increased attention to all healthcare system levels [16]. In the first stage of this study (before intervention), the mean status of nursing healthcare-related to patient safety in the ICU was 44.32% in the 12 categories which was at the inappropriate level. The highest rate of observation of care related to patient safety in the ICU pertained to "blood transfusion and prevention of its complication" (89.52%), which was at an appropriate level. The lowest rate of observation of patient safety standards belonged to "prevention of bedsore (1.87%), which was at an unacceptable level. Nurses' performance was unacceptable (48.94%) before implementing the corrective training intervention, which increased to the

appropriate level (94.44%) after implementing the corrective training program considering the first category of patient safety standards. Patient assessment is one of the nurses' primary roles, which involves assessing patients to understand changes in their conditions, initial diagnosis, clinical crisis, and protection of the patient against errors and damages [17]. Nurses should know how to perform this assessment and know how the assessment is interpreted and practiced on them [18]. It can be concluded from the studies conducted in this field [19, 20]. That patient assessment hinders detrimental damages to the patient and prevents delayed treatment serving as an important category in observing patient safety. Thus, considering the significance of assessment, some training on primary assessment was provided for ICU nurses in this study. An improvement was observed in nurses' performance after they were observed again. Regarding the second category of observation of patient safety, i.e., "paying attention to drugs with similar names or pronunciations and making sure of the accuracy of drug therapy," the results revealed that the observation of patient safety was at an unacceptable level (45.87%) before intervention which increased to the appropriate level (91.37%) after implementing the corrective training program and thence enhancing the drug standards. Unpredictable detrimental reaction to the drug occurs daily in hospitals affecting the mortality rate. The ICU patients are potentially exposed to adverse drug events (ADEs) [19]. Observation of patient safety in the third category, i.e., "performing the correct procedure on the right side of patient's body," increased by 45.5% after implementing the training program compared to before the program, reaching the appropriate level. Moreover, concerning the fourth category, there was a significant increase (84%) in "avoiding wrong connections of catheters and tubings." No study was found in the library search on these two categories of patient safety in ICUs; yet, reference can be made to the study by Cherian & Karkada (2015) to confirm training efficacy. Their study was conducted in ICUs of Dubai hospitals aiming at investigating the effect of training workshops on awareness and performance of nurses' oral care and its related clinical outcomes in mechanically ventilated patients and found that nurses' performance in oral lavage was promoted by 96.7% with ventilator-associated pneumonia reaching to 0.00% [15]. Considering the fifth category, i.e., "patient gavage," the nurse's understudy performed the patient safety care at the moderate level (64.25%), which increased to the appropriate level (99%) after implementing the training program. Changes in the awareness and clinical performance of the treatment staff result from training interventions. However, repeated interventions are necessary to achieve acceptable changes based on adult learning theory [20]. Investigating the patients at risk of falls and selecting the most appropriate method of

preventing such falls and the related harms lie among the nurses' responsibilities. The personnel's tactfulness in assessing the fall risk is a vital factor in determining how nurses will be able to diminish the rate of measured falls by selecting proper fall intervention [21]. This study's nurses' performance was near the unacceptable level in this category before implementing the training program. Krauss et al. (2008) demonstrated that increasing nurses' knowledge of preventing patient fall rates decreased the rate of inpatients fall [21]. Additionally, Saleh & Shloul (2011) concluded that a continuous hourly nursing round system reduced patient falls. These studies are consistent with our results that nurses' training improves their performance to the appropriate level. Graham (2012) reported 92% of lack of correspondence between nursing performance and safety standards in which 92% of errors resulted from lack of control of bed handrails, lack of proper patient-to-nurse proportion, and shortage of space between the beds. Their study showed a 25% reduction in patient falls after reassessment four months after the initial study [22]. Based on our findings, nursing care related to patient safety in the seventh category, i.e., "prevention of deep vein thrombosis (DVT) and emboli," was at the unacceptable level (37.57%) before the intervention, which increased to the appropriate level (96.42%) after implementing the training program. Physical examinations are not useful in exactly diagnosing the DVT in ICU patients. Although venography is a standard method of diagnosing DVT, it is invasive and expensive. Moreover, it involves more problems like patient transfer, positioning, and X-ray exposure [23]. In a retrospective cohort study by Khouli, Shapiro, & Philipham (2006) on ICU patients and patients with suspected lower extremity thrombosis, the DVT rate at admission was %2.7, which increased to 9.6% during hospitalization [24]. According to the findings by Minet et al. (2015), the high risk of affliction with DVT in ICU patients is worrisome, especially when it is aggravated by risk factors like mechanical ventilation, vasoconstrictors, and the use of central venous routes in this ward [23]. It appears in the present study that, in addition to therapeutic interventions and the use of elastic stockings for these patients, the promotion of ICU nurses' knowledge of nursing care related to the prevention of DVT in high-risk patients is mandatory. Regarding the eighth category in this study, i.e., "prevention of bedsore," the rate of correspondence between nursing cares increased from an inappropriate level (1.87%) to the appropriate level (95.12%) after implementing the training program. Apostolopoulou, Tselebis, Terzis, Efstathia, Ioannis, & Andreas (2014) worked on the importance of prevention of bedsores in ICU patients in Greece and reported the rate of incidence of pressure sores as 29.6% in ventilation-assisted patients [25] (Apostolopoulou et al., 2014). Also, Rogenski & Kurcgant (2012) referred to the 40% rate of pressure

sores in ICU patients, which decreased to %23.1 after implementing the prevention protocol [26]. Regarding the ninth category, i.e., "prevention of nosocomial infections," measures such as incorrect washing of the hands before and after patient care-giving, lack of attention to oral health and facial and ocular care in unconscious patients, abnormal respiratory symptoms, and fever or pyrexia in the present study, the results before intervention suggested that these measures lay far from standards (37.88%) which increased to 96.8% after intervention reaching the appropriate level. The rate of nosocomial infections is much higher in patients admitted to intensive care units (ICU) than for patients on general medical or surgical wards. Randa et al (2014) worked in Egypt on promoting the nurses' competency in exercising standard precautions of infection control in pediatric ICUs and showed that nurses' performance in washing and scrubbing the hands, wearing gowns and gloves, and wearing masks was far from standards [27]. Moreover, the study by Keller & Andrew (2008) conducted in Brazil on suction performance safety indicated that the ICU nurses do not perform the suctioning according to the best recommended methods (observation of infection control precautions) (Kelleher & Andrews, 2008) Contrary to our findings, the study by Pinto, Schons, Busanello, & Costa (2015) carried out in Brazil on patient safety and dermal and mucosal irritation and injury by invasive airway instruments suggested that 90% of individuals observed the specialized tracheostomy care to prevent damage and schism or split in tracheostomy patients. Moreover, 98% of the participants announced that they perform the required examinations to suction the patient's airway secretions on the basis of the standards. Yet, regarding the care for the cuff of intratracheal tube, %40 of them performed the care on the basis of the standards [28]. The tenth category, i.e., "blood transfusion and prevention of its complications", was appropriate (89.52%) in our study which increased to 100% after intervention. Blood transfusion as a medical procedure is an integral component of modern health care. If it is applied correctly, it can save human lives and improve their health status. Knowledgeability in safety standards and their adherence and practice are considered important health providers' measures to avoid adverse consequences. Proper training of the staff is mandatory to assure of efficient and professional service provision [29]. From the authors' perspective, educational conferences held continuously in the hospital with the obligatory presence of all the nursing and midwifery staff and sometimes physicians significantly affect the nurses' performance to the national standards. Contrary to this finding, the results of the study by Hijji, Oweis, & Dabbour (2012) conducted in Jordan on investigating the Jordanian nurses' awareness of blood transfusion showed that 51.3% of the nurses gained an average mean score while most of them lacked any knowledge

regarding blood preparation before transfusion. The researchers in that study attributed this problem's possible cause to lack of continuous education of nurses in blood transfusion [30]. Considering the eleventh category, i.e., "prevention of surgery complications", the nurses' performance was assessed to be inappropriate (28%) before intervention which increased to 97.62% after training program. The results of the study by Snowdon & Skinner (2014), aimed at surveying the effect of interventions before surgery on reducing pulmonary complications in cardiac surgery patients in Australia demonstrated a significant decrease in the time of weaning the patient from the ventilator and development of postoperative complications of pulmonary surgery after implementation of pre- and postoperative care [31]. This is consistent with our results. Nurses play an obvious part in observing the direct care standards related to patients with invasive airway instruments [28] (Pinto et al., 2015). The mean score of observing the patient safety standards in the last category, i.e., "prevention of intratracheal tube and ventilator complications," was at the unacceptable level (36.27%), which increased to the appropriate level (93.59%) after implementing the training program. Patients receiving mechanical ventilation in the Intensive care Unit are more likely to ventilator-associated Pneumonia with Fatal complications [32]. Subramanian, Choy, Gobal, Mansor, & Hoong (2013) conducted a study on ventilator-associated pneumonia to examine the effect of training on ventilator-associated hospital-acquired pneumonia in ICUs. They found that this infection's prevalence in intratracheal patients was reduced from 39 per 1000 cases to 15 per 1000 cases during a two-month intervention [33] (Subramanian et al., 2013). In the study by Cherian & Karkada (2015) conducted in Dubai, ICU nurses' awareness and performance in giving oral care to ventilator-assisted patients were at the moderate level for 46.7% of the nurses, while they scored 56.7% in the oral nursing care, indicating that nurses' performance in giving oral care to ventilator-assisted patients was not at the appropriate level which increased to 100% after the intervention [15] (Cherian & Karkada, 2015). Regarding the observation of patient safety standards in hospital ICUs under study, it may be concluded that on average, the scores were at the unacceptable level (44.32%) in the 12 categories, which increased to the appropriate level (95.61%) after the intervention. Reference may be made to Cherian & Karkada (2015) to approve this finding, who carried out their study in Dubai in a hospital ICU to investigate the effect of training workshops on the awareness and performance of nursing care and found that the nurses' performance score improved after training reaching 96.7%. Also, the rate of ventilator-associated pneumonia reached 0.00 during and after the study [15] (Cherian & Karkada, 2015). Educational and training interventions have been properly used to

encourage changes in the nurses' behavior using adult learning theories to foster learning in clinical wards. Receiving frequent feedback is mandatory to achieve acceptable changes in behavior. Hence, when the corrective training interventions are continuously provided, the feedback for implementing that intervention ought to be planned beforehand [20]. Moreover, the results of the study by Bassuni & Bayoumi (2014) suggested positive changes in teamwork atmosphere and the rate of nurses' annual circulation in ICUs. On the other hand, there was a general increase in awareness, tactfulness, and attitude of nurses towards patient safety dimensions [34].

## CONCLUSIONS

Training and learning of patient safety are among the most important duties to warrant safe care to patients; nonetheless, this topic demands a longer time to fulfill the promotion of patient safety culture. Given that patient safety is extensively intermingled with training and education, and staff training can promote knowledge and expertise, create favorable attitudes, and improve performance in patient caregiving, it could be concluded that lack of education and clinical expertise for treatment staff is one of the leading causes of medical errors in care-giving. Teaching and research on patient safety are rendered as one of the implementation tools of patient safety promotion in the healthcare systems. Various studies approve the effect of training on reducing medical errors and increasing problem-solving capacity, especially for inexperienced or low-experienced individuals [33]. According to our results, although most ICU nurses have passed the educational courses on patient safety, risk management, blood transfusion, medicine, and ventilator-assisted patient caregiving; they did not have appropriate performance in most categories under study. This is due to either insufficient familiarity with the method of care-giving to ICU patients or lack of proper training in these fields. In both cases, a review and revision of the content of nursing care educational courses for ICU patients and also examining the degree of its applicability are mandatory.

Consequently, it is urgently necessary for healthcare experts to get familiar with patient safety dimensions and improve the present status to fulfill the healthcare goals through conducting applied research. Given that teaching hospitals in the country play a significant role in providing healthcare, they provide a suitable context for analysis based on patient safety to analyze the etiologic causes of damages imposed on the patients. The application of quality control in hospitals and holding appropriate educational courses for nurses provide a context for nurses to learn the most up-to-date performance standards and therapeutic methods. Also, having orientation sessions to familiarize nurses with

clinical governance, validation standards, and patient safety standards is a significant step in reducing medical errors and promoting patient safety awareness. Ultimately, our findings revealed that the implementation of continuous educational programs effectively increases nurses' understanding and performance via constant supervision and control.

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#### Author's Contributions

Mansoureh Zagheri Tafreshi and Houman Manoochehri contributed to the design and implementation of the research. Alirez Akbarzadeh Baghban collaborate on the analysis of dissertation and information collection.

#### Conflict of Interest

This research has not been sponsored by any organization and there is no conflict of interest in it.

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