- # Basic Research

Effectiveness of In-service Training Program on Nurses' Performance Regarding Patient Safety Practice Standards in Intensive Care Units

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Abstract

Background: Patient safety is a framework of organized activities that creates cultures, processes, procedures, behaviors, technologies, and environments in health care that consistently and sustainably: lower risks, reduce the occurrence of avoidable harm, make errors less likely and reduce its impact when it does occur. Nurses have tragedy a censoriously vital role in confirming patient safety whereas as long as give care directly to patients. This study **aimed** to evaluate the effectiveness of in-service training program on nurses' performance regarding patient safety practices standards in intensive care units. **Design:** A quasi-experimental research design was utilized. **Setting:** The study was conducted at the main intensive care unit at the surgical building affiliated with Ain Shams University Hospital (El-Demerdash). **Subject:** A purposive sample of comprised of 65 staff nurses was working in previous mentioned setting. **Tools: (I)** A structured interviewing questionnaire; it covered demographic characteristics of nurses and interview knowledge questionnaire, **(II)** Nurses' practical observational checklist. **Results:** There were improvements in the studied nurses' satisfactory level of knowledge and competent level of practice throughout pre/post and follow up phases, with a highly statistically significant difference between pre/post at ($P < 0.003$). There was statically highly significant relation between total level of studied nurses' knowledge and practice for pre/post and follow-up at $P > 0.000$. **Conclusion:** The nurses' knowledge and practice regarding patient safety practice standards in intensive care units have been effectively improved throughout pre/post and follow-up phases of an in-service training program implementation. **Recommendation:** Designing a written educational programs and implementation of regular updating of nurses' knowledge and practices concerning patient safety practices standards in intensive care units.

Key words: Nurses, Patient Safety, in-service training program, Patient Safety Practices Standards.

Introduction

Patient safety is the prevention of errors and adverse effects to patients associated with health care which is always top of mind. Patient safety is a structure of prearranged activities that creates cultures, processes, procedures, behaviours, technologies, and environments in health care that constantly and sustainably: lower hazards, decrease the incidence of preventable harm, make errors less likely and reduce their impact when it does **(World Health Organization, 2022)**.

Healthcare conveniences are stimulated to implement innovative practices that will address these concerns and eventually advance patient precaution by decreasing preventable harm events. The Joint Commission has outlined seven patient safety goals for hospitals which were including: identifying patients correctly, improving staff communication, using medicines safely, using alarms safely, preventing infection, identifying patient safety risks, and preventing mistakes in surgery **(The Joint Commission, 2022)**.

As reported by the Egyptian Healthcare Accreditation Program, Standards for Hospitals present safe practices (standards) under three main headings which were including: General Patient Safety (Policies and procedures, staff orientation and education, patient identification, hand hygiene, injection safety, verbal and telephone orders, panic values, catheter and tubing misconnection, fall prevention, pressure ulcer prevention, critical alarms, and handover communication), medication management safety (Policies and procedures, high risk medication, dangerous abbreviation, look---alike and sound-alike, concentrated electrolytes, medication labeling, and medication reconciliation), and operative and invasive procedure safety (Policy and procedures, pre-intervention checklist, patient identification, time out, and site marking equipment retention **(The Egyptian Ministry of Health and Population, 2021)**.

Education and in-service training play a significant role in attaining governmental goals through a combination of governmental and staff interests. Nowadays, training is a crucial element contributing to internal advancement, staff improvement, and achievement of organizational plans. Actually, there is a clear arrangement of the quality healthcare services across the world that should be effective, patient-focused, and safe. For the worthwhile implementation of patient safety approaches, skilled health care experts, management dimensions, clear strategies, data to initiate safety improvements, and effective participation of patients in their care are essential to develop and adopt new models of experimental education for nurses **(Chaghari, et al., 2017 and Wake, et al., 2021)**.

In-service training consists of a set of procedures taken to encourage authorization and proficiency among staff for the improved responsibility of their tasks, thus assisting the

association to achieve its objectives **(Sajjadnia, et al., 2015)**. Really, continuous in-service training assists to appraise the nurses' professional knowledge and skillful practice for achieving several responsibilities besides tasks. The additional significant point relating to the in-service training of the nursing staff is their dynamic participation in such programs which is leading to effective learning and development in their field of work **(Chaghari, et al., 2017)**.

According to The Agency for Healthcare Research and Quality, the most common medical errors include adverse drug events, catheter-associated urinary tract infections, central line-associated bloodstream infection, injury from falls and immobility, pressure ulcers (Bed sores), surgical errors (Human factors, wrong-site surgery, wrong labelling of the specimen or waste, and surgical site infections, venous thrombosis (Blood clots), ventilator-associated pneumonia **(Rodziewicz, et al., 2022)**.

Nurses were tragedy a censoriously vital role in confirming patient safety whereas as long as care directly to patients compared to physicians may only spend 30 to 45 minutes a day with even a critically ill hospitalized patient. From a patient safety outlook, a nurse's role consist of observing patients for medical diagnosis, discovering errors and proximate misses, considerate care processes and weaknesses characteristic in some systems, recognizing and communicating alterations in patient condition, and accomplishment immeasurable other tasks to ensure patients receive high-quality care **(PHILLIPS, ET AL., 2021)**.

In recent years, quality-of-care enhancement and prevention of practice errors are reliant on nurses' adherence to standards and the prevention and reduction of practice errors. Conversely, suboptimal quality and safety of care continue evident, signifying the need for developed understanding and levels of nurses' knowledge of the various factors and conditions that increase adherence in daily nursing practice. Consequently, nurses are necessary for establishment of in-service perfection of knowledge and practice regarding institutional procedures or protocols and also, empowerment of the personal factors that impact the nurses' adherence to patient safety principles **(Vaismoradi, et al., 2020)**.

Significance of the study

As stated by the World Health Organization, the conception of patient safety (PS) is to decrease the risk and absolutely avoid the preventable one that is connected with delivered healthcare. The occurrence of adverse events due to unsafe care is likely one of the 10 leading causes of morbidity and mortality across the world. It is estimated that one in every 10 patients is harmed while getting hospital care. It is appraised that there are 421 million of hospitalized patient in the world annually, and approximately 42.7 million adverse events occur in patients throughout these hospitalizations. Each year, 134 million adverse events

occur in hospitals in low- and middle-income countries due to unsafe care, resulting in 2.6 million deaths every year (**World Health Organization, 2020 and Dhingra-Kumar, et al., 2021**). In Egypt; overall, the previous studies showed that patient safety is delicate in ICUs, and more determination is suggested to increase the awareness of health care providers (**Salem, et al., 2019 and El-Sherbiny, et al., 2020**).

Aim of the study: This study was conducted to evaluate the effectiveness of in-service training program on nurses' performance regarding patient safety practices standards in intensive care units through:

- Determine the level knowledge of nurses regarding the patient safety practices standards in intensive care units
- Determine the level practice of nurses regarding the patient safety practices standards in intensive care units
- Designing and implementing an in-service training program on nurses' performance regarding patient safety practices standards in intensive care units
- Evaluate the effectiveness of an in-service training program on nurses' performance regarding patient safety practices standards in intensive care units.

Research hypotheses:

H1. The studied nurses will have a statistically significant improvement in knowledge level post an in-service training program adherence as compared to preprogram implementation.

H2. The studied nurses will have a statistically significant improvement in practice level post an in-service training program adherence as compared to preprogram implementation.

H3. There will be correlation between total level of knowledge and total level of practice throughout the in-service training program adherence as compared to preprogram implementation.

Operational definition:

The in-service training program: A set of preplanned objective (the knowledge and practice) for specific topic (the patient safety standards) and target nurses, which involve designed pretest, the learning materials and educational activities to improve nurses' knowledge and practice, maintain patients' safety, and measures to prevent incidence of complications then post-test and follow up.

Subjects and Methods:

Research design: The quasi-experimental research design was used to conduct this study.

Setting: The study was conducted at the main intensive care unit which consists of (Unit 1 (15 nurse), unit 2 (11 nurse), unit 3 (9 nurse), unit 4 (9 nurse), and unit 5 (11 nurse)) located in the 1st floor and intensive care unit B (10 nurse) located in 2nd floor at the Surgical Building affiliated to Ain Shams University Hospital (El-Demerdash).

Subjects: A Purposive sample of (65) staff nurses who met the inclusion criteria, working and spent the training internship year at the Surgical Building affiliated to Ain Shams University Hospital (El-Demerdash) and chosen by convenience sampling technique.

Inclusion criteria:

Staff nurses of both sexes who agree to participate in the study, were not been exposed before to any teaching or an in-service training program on nurses' performance regarding patient safety practices standards in intensive care units.

Tools for data Collection:

Data for this study were collected using the following tools:

<u>**Tool I:**</u> **Nurses Structured Interview Questionnaire:** It consists of the following parts:

<u>**Part 1:**</u> **Demographic characteristics**: it included gender, age, residence, level of education and position, experience years, and previous training courses for Egyptian patient safety standards for hospitals.

<u>**Part 2:**</u> **Nurses interview knowledge questionnaire**: to assess nurses' knowledge (pre/post and follow-up): This questionnaire was designed by the researchers' in the Arabic language after reviewing the related literature. The items on this sheet were adapted from **the Egyptian Ministry of Health and Population (2021)** to assess patients' knowledge of Egyptian patient safety standards for hospitals; it included the following 4 Dimensions:

<u>**Dimension I:**</u> To assess nurses' knowledge regarding The Egyptian and WHO patient safety recommendations and solutions. It consists of 8 items.

Dimension II: To assess nurses' knowledge regarding general patient safety (Policies and procedures, staff orientation and education, patient identification, hand hygiene, injection safety, verbal and telephone orders, panic values, catheter and tubing misconnection, fall prevention, pressure ulcer prevention, critical alarms, and handover communication). It consists of 19 items.

Dimension III: To assess nurses' knowledge regarding medication management **safety** (Policies and procedures, high risk medication, dangerous abbreviation, look---alike and sound-alike, concentrated electrolytes, medication labeling, and medication reconciliation). It consists of 21 items.

Dimension IV: To assess nurses' knowledge regarding operative and invasive procedure safety (Policy and procedures, pre-intervention checklist, patient identification, time out, and site marking equipment retention). It consists of 8 items.

 Scoring system: The total score of patients' knowledge was (56) grades, 1 grade were given to the correct answer and zero to the incorrect answer. Total score was considered as the following:

- ≥ 80% was considered satisfactory level of knowledge.
- < 80% was considered unsatisfactory knowledge.

Tool II: Nurses' practical observational checklist: It was adapted by researchers and written in Arabic language based on the related literatures to evaluate the nurse practice regarding patients' safety practice throughout the in-service training program implementation. The observational checklists were composed of the following 7 main factors:

Factor I: Patient identification: To assess nurses' skills related to the patient identification adapted from **The Joint Commission (2021)**, it consists of 7 items.

Factor II: Communicating verbal order: To assess nurses' skills related to communicating verbal order adapted from **the Institute for Safe Medication Practice (2017)**, it consists of 14 items.

Factor III: Standard precautions in health care: Infection control - standard and transmission-based precautions: To assess nurses' skills related to standard precautions in health care: infection control - standard and transmission-based precautions adapted from **World Health Education (2021)**, it consists of 9 items.

Factor IV: Management of falls and sores: To assess patients' skills related to management of falls and sores adapted from **Yang (2021)**, it consists of 9 items.

Factor V: Management of mechanical ventilated patients: To assess nurses' skills related to management of mechanical ventilated patients **Li, Chen and Li (2012)**, it consists of 10 items.

Factor VI: Medication management safety: To assess nurses' skills related to medication management safety, it consists of 9 items.

Factor VII: Operative and Invasive Procedure Safety: To assess nurses' skills related to operative and invasive procedure safety, it consists of 6 items.

Scoring system: The total score of nurses' practice observational checklists was (64) grades, 1 grade was assumed to be the step which was done correctly and zero for the step which was done incorrectly or not done. The total score was considered as the following:

- ≥ 80% was considered the competent level of practice.
- < 80% was considered the incompetent level of practice.

Proposed in-service training program: An in-service training program was developed based on analysis of the staff nurses' pre-test knowledge and practice score, review of literature and discussion with the guide and other experts, development of criteria checklist, preparation of the first draft and application content validity of in-service training program then preparation of final draft (**The Joint Commission, 2022 and The Egyptian Ministry of Health and Population, 2021**).

Operational Design:

The operational design included a preparatory phase, pilot study, the validity of the modified tool and reliability, ethical consideration, and fieldwork.

Preparatory Phase:

It included appraising recent and previous available literature and theoretical knowledge of several features of the study using the booklet, articles, internet, periodicals, and magazines in order to develop the data collection tools.

Validity:

Face and content validity mean the instrument that measures what is intended to be measured **(Borgstede, Buntins & Eggert, 2017; Middleton, 2021)**. It was conducted to test the tool for appropriateness, relevance, correction, and clearance through a jury of five experts, from the Medical-Surgical nursing staff at the Faculty of Nursing, Helwan University. Juries were from different academic categories (professors and assistant professors). Their opinions were elicited regarding the tool format layout, consistency, and scoring system.

Testing reliability:

It is a degree to which the used tools measure what was supposed to be measured in the same way each time & under the same condition with the same subjects **(Borgstede, Buntins & Eggert, 2017; Middleton, 2021)**. It is tested by using the Cronbach alpha test the reliability scores of study tools including the Arabic version, for tools I, and II were (0.879 & 0.912) for patient's interview knowledge questionnaire and nurses' practical observational checklist, respectively.

Ethical Considerations:

Formal consent was taken from nurses who agree to participate in the research process after the aim of the study has been basically clarified to them preceding data gathering. They were confident that anonymity and confidentiality would be assured and the right to take out from the study at any time without giving any reason. Values, culture, and beliefs would be respected.

Pilot Study:

A pilot study was applied to a group of 6 nurses (10% of the sample) to test the applicability of the tools and clarity of the designed questionnaire, as well as to estimate the time desirable to answer them. Nurses included in the pilot study were also included in the main study subject, because there were no modifications to the tools.

Field Work:

- Data collection was started and accomplished within 6 months from the beginning of August 2021 until January 2022.
- Data were collected through four phases: Assessment, Planning, installation, and evaluation phase

- Purpose of the study was clarified by the researchers to nurses who agreed to participate in the study prior to any data collection.
- The study tools were filled in and completed by the researchers three times on 3 stages (pre & post and follow-up after three months from in-service training implementation phases).
- The researchers were available at intensive care units at the Surgical Building affiliated with Ain Shams University Hospital (El-Demerdash) 3 days/a week during morning and afternoon shifts to collect data from the studied nurses. Filling in the tools was done according to the nurses` working hour schedule and their condition.

The collection of data was done through three phases:

Phase I: Assessment phase:

- In this phase; the researchers collected data from nurses (the study group). It was begun with the nurses' demographic characteristics sheet, interview knowledge questionnaires were filled in by the researchers or by nurses for each nurse according to their level of education; it had filled within (20-30) minutes for every nurse.

- Nurses had been observed and interviewed by the researchers using practical observational checklists to assess and measure the effectiveness of nursing staff practice. The researchers were noting down what they saw and what the nurses said as it was happening. It had filled within (30-40) minutes for every nurse.

Phase II: Planning phase:

Proposed nursing in-service training program:

- It was designed to improve nurses' knowledge and practical level regarding the patient safety standards. Based on nurses' knowledge prerequisites, the researchers developed the in-service training program in the Arabic language including the following contents; knowledge regarding the patient safety standards (The Egyptian and WHO patient safety recommendations and solutions, the Egyptian patient safety standards for hospitals include (the standard general patient safety, the standard medication safety, and preoperative and invasive procedure safety).

-The practical part was designed based on The Joint Commission safety goal, WHO patient safety recommendations and solutions and the Egyptian patient safety standards for hospital) it included (patient identification, communicating verbal order, using standard

precaution on health care, management of fall and sore, management of mechanical ventilated patient, medication safety and operative and invasive procedure). Then Apply validity for the in-service training program. The in-service training program material was developed using related literature, researches and web citation **(World Health Organization, 2022; The Joint Commission, 2022 and The Egyptian Ministry of Health and Population, 2021)**.

.**Phase III: Implementation phase:**

- In this phase, the nurses' demographic characteristics and structured interview knowledge questionnaire sheets were filled in nurses. It had taken about 30 minutes to be filled in for every nurse

-Nurses were observed and interviewed by the researcher using practical observational checklists to assess their appraisal form and measuring the effectiveness of nursing staff practice. This method involves noting down what researchers see and what the nurses say as it was happening. It had taken 30 minutes for every nurse.

-The in-service training program material was explained to nurses over two days for every 2 to 3 patients together according to their level of education and working hours through group discussion and given a handout and brochure. The participants had in-service training at a time in a sequential manner through demonstration and re-demonstration and role play.

- The in-service training program was evaluated on the same day with the following instructions; apply pre-test before it then complete post-test, keep the in-service training handout with them to read it, and follow up done after 3 months. Nurses were allowed to ask questions in case of misunderstanding while listening and expressing interest in them. At the end of the program sessions, the researchers emphasized that they will be followed up by the researchers after three months.

Phase IV: Evaluation phase

- Post implementation of the nursing in-service training program, all tools except nurse's demographic characteristics sheet were refilled in again after 3 months to evaluate the effect of the nursing practical adherence outcomes and their professional knowledge compared to the results pre/post implementation.

Administrative Design

Official approval has been gotten from the Hospital Director Nursing Director of Ain Shams University Hospital (El-Demerdash). Official letters were issued to them from

the Faculty of Nursing at Helwan University which was explaining the aim of the study to obtain permission for the collection of data.

Statistical Design:

The collected data were analyzed using (SPSS) version 24. Qualitative data were presented as numbers, percentages, mean and standard deviation. A Chi-square and paired sample t-test test was used to detect the relation between the variables. Relations between different qualitative variables were tested using the correlation coefficient (person correlation). Probability (p-value) ≤ 0.05 was significant, < 0.001 was highly significant and > 0.05 was non-significant **(Salcedo & McCormick, 2021)**

Results

Table (I) The percentage distribution of demographic characteristics of nurses under the study illustrated that about two-thirds of studied nurses were females. As well as, 66% of the study nurses were between 25-35 years with a mean age of (29.28 ± 5.45) years. As regards the nurses' educational level, 44.6% of the studied nurses had technical nursing education by means 41.5% of the studied nurses had experienced (3 - < 5) years, while 29.2% of them had less than 3 years and the same percentage had more than 5 years with the mean years of their experience were (4.05 ± 2.93) years. Additionally, 52.3% of the studied nurses had working hours (> 48) per week. Concerning attending the training courses, 52.3% of the nurses attend training courses interrelated to general patient safety, while 83% of them did not attend training courses related to Egyptian and WHO patient safety standards for hospitals.

Figure (1) Percentage distribution of satisfactory level of nurses' knowledge regarding The Egyptian and WHO Patient Safety recommendations and solutions throughout pre/post and follow-up phases only (35.4, 38.5, 44.6, 32.3, 44.6, 58.5, 38.5 and 41.5%)of the study subjects gave correct answer regarding (Accurate standardized patient identification in all service areas, standardized process for dealing with verbal or telephone orders, handing critical values/tests, hand hygiene throughout the organization, prevention of catheter and tubing misconnections, prevention of patient's risk of falling, prevention of patient's risk of developing pressure ulcers, and a standardized approach to hand over communications) at pre-implementation. Compared to (96.9, 96.9, 92.3, 95.4, 96.9, 96.9, 98.5, and 95.4%) who had a satisfactory level of knowledge three months after the in-service training program implementation at the follow-up phase, respectively, with a highly statistically significant difference for pre/post and post and follow-up phases at $p < 0.001$.

Table (2): Percentage distribution of satisfactory level of nurses' knowledge regarding Egyptian patient safety standards for hospitals throughout pre/post and follow-up phases displayed that, only (47.7, 67.7, 61.5, and 36.9%) of the study subjects gave correct answers regarding Dimension of knowledge which includes (The Egyptian and WHO patient safety recommendations and solutions, standard general patient safety, standard medication safety, and preoperative and invasive procedure safety) at pre-implementation compared to (96.9, 96.9, 89.2, and 95.4%) who had a satisfactory level of knowledge three months after in-service training program implementation at the follow-up phase, respectively, with highly statistically significant differences for pre/post phases at $p < 0.001$.

Table (3): Percentage distribution of nurses' competent level of practice regarding factors of patient safety practice throughout pre/post and follow-up phases validated that, there were improvement in the studied nurses' competent level of practice from (81.5, 66.2, 56.1, 78.5, 72.7, 86.2 and 81.5%) at pre-implementation compared to (100.0, 87.7, 96.9, 96.9, 93.8, 100.0 and 98.5%) who had a competent level of practice three months after the in-service training program implementation at the follow-up phase, respectively, with highly statistically significant differences between pre/post at $P < 0.001$.

Table (4) Comparison of Mean scores among the study subject regarding the total level of nurses' knowledge and practice throughout pre/post phases and follow-up phases clarified that, there were improvement in the studied nurses' satisfactory level of knowledge and competent level of practice at pre/post phases, respectively, with highly statistically significant differences between pre/post at ($P < 0.003$).

Table (5) Correlation between total level of nurses' knowledge and practice throughout pre/post phases and follow-up phases revealed that, there was a statically highly significant relation between total level of studied nurses' knowledge pre-test and practice for pre/post and follow-up at $P > 0.000$. While there were highly statistically significant relations between the total level of studied nurses' knowledge post-test and practice for pre-test and post-test phases ($X2=22.323$ and 2.537 respectively) at $p < 0.014$. Whereas there was a highly statistically significant relationship between the total levels of studied nurses' knowledge follow-up test and nurses' practice pre/post-test at ($p < 0.016$).

Table (1): The percentage distribution of demographic characteristics of nurses under the study (n=65).

Item	Number	%
Gender		
Female	44	67.7
Male	21	32.3
Age (Years)		
20 - < 25	11	16.9
25 - < 30	19	29.2
30 - < 35	24	36.9
35 +	11	16.9
Mean ± SD	**29.28 ± 5.45/ 2.54 ± .969**	
Educational level		
Diploma of nursing	10	15.4
Technical Institute of nursing	29	44.6
Bachelor of nursing	10	15.4
Internship year	16	24.6
Job categories		
Staff nurse	42	64.6
Charge nurse	21	32.3
Head nurse	2	3.7
Experience (Years)		
< 3	19	29.2
3 - < 5	27	41.5
5 +	19	29.2
Mean ± SD	**4.05 ± 2.93 / 2.00 ± .771**	
Working hours		
30 - < 42	12	18.5
42 - 48	19	29.2
> 48	34	52.3
Mean ± SD	**49.02 ± 10.530/ 2.34 ± .776**	
Training courses for Egyptian and WHO patient safety standard for hospitals		
No	54	83
Yes	11	17
Training courses for general patient safety		
No	31	47.7
Yes	34	52.3

Figure (1): Percentage distribution of satisfactory level of nurses' knowledge regarding The Egyptian and WHO Patient Safety recommendations and solutions throughout pre/post and follow up phases (n=65).
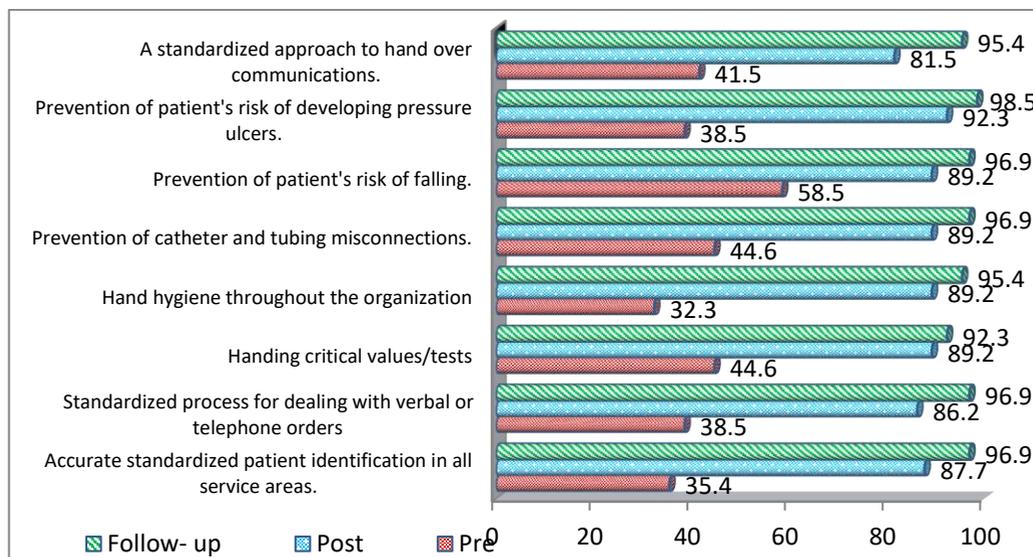
Table (2): Percentage distribution of satisfactory level of nurses' knowledge regarding Egyptian Patient Safety Standards for Hospitals at throughout pre/post and follow up phases (n=65).

Dimension of knowledge	Pre		Post		X2 test		Follow up		X2 test	
	Satisfactory		Satisfactory		Pre/post		Satisfactory		post/ Follow up	
	no	%	no	%	X2	P	no	%	X2	P
Dimension 1: The Egyptian and WHO Patient Safety recommendations and solutions	31	47.7	64	98.5	19.24	0.000	63	96.9	18.59	0.000
Dimension 2: Standard general patient safety	44	67.7	64	98.5	24.46	0.000	63	96.9	19.847	0.000
Dimension 3: Standard medication safety	40	61.5	64	98.5	17.78	0.000	58	89.2	3.65	0.001
Dimension 4: Preoperative and invasive procedure safety	27	36.9	64	98.5	6.913	0.000	62	95.4	3.976	0.000

P < 0.01 High Significant, P < 0.05 Significant & P > 0.05 No significant

Table (3): Percentage distribution of competent level of nurses' practice regarding factors of patient safety practice throughout pre/post and follow-up phases (n=60).

Factors of practice	Pre competent		Post competent		X2 test Pre/post		Follow up competent		X2 test post/ Follow up	
	no	%	no	%	X2	P	no	%	X2	P
Factor 1: Patient identification	53	81.5	62	95.6	11.005	0.000	65	100	3.386	0.001
Factor 2: Communicating verbal order	43	66.2	50	76.9	12.044	0.000	57	87.7	3.535	0.001
Factor 3: Infection control - standard and transmission-based precautions	47	56.1	59	90.8	11.074	0.000	63	96.9	3.444	0.001
Factor 4: Management of falls and sores	51	78.5	61	93.8	10.200	0.000	63	96.9	1.379	0.173
Factor 5: Management of mechanical ventilated patients	47	72.7	64	98.5	10.605	0.000	61	93.8	2.709	0.009
Factor 6: Medication management safety	56	86.2	64	98.5	10.547	0.000	65	100	1.725	0.089
Factor 7: Operative and Invasive Procedure Safety	53	81.5	64	98.5	13.734	0.000	64	98.5	1.507	0.137

Table (4): Comparison of Mean scores among the study subject regarding total level of nurses' knowledge and practice throughout pre/post and follow up phases (n=65).

Items	Pre- test	Post- test	X2 test Pre/post			Follow-up	X2 test Post/follow-up		
	Mean ±SD	Mean ±SD	X2	P	R	Mean ±SD	X2	P	r
Total knowledge	1.72± 0.47	1.89 ± 0.063	20.107	0.000	0.291	1.84 ± 0.084	3.089	0.003	0.198
Total practice	1.54 ± 0.065	1.82 ± 0.085	21.027	0.000	0.040	1.87 ± 0.070	3.678	0.000	0.154

P < 0.01 High Significant, P < 0.05 Significant & P > 0.05 No significant

Table (5): Correlation between total level of nurses' knowledge and practice throughout pre/post phases (n=60).

Total practice	Total knowledge			
	Pre			
	Mean± SD	**r**	**X2**	**P**
Pre-test	0.187 ± .074	0.167	20.365	0.000
Post-test	0.098 ± .083	0.314	9.463	0.000
Follow-up	0.152 ± .079	0.135	15.462	0.000
	Post			
	Mean± SD	**r**	**X2**	**P**
Pre-test	0.311 ± 0.15	0.112	22.323	0.000
Post-test	0.026 ± 0. 083	0.519	2.537	0.014
Follow-up	0.027 ± 0.115	0.112	1.953	0.055
	Follow-up			
	Mean± SD	**r**	**X2**	**P**
Pre-test	0.355 ± 0.090	0.025	31.866	0.000
Post-test	0.070 ± 0.116	0.196	4.879	0.000
Follow-up	0.016 ± 0.052	0.699	2.483	0.016

P < 0.01 High Significant, P < 0.05 Significant & P > 0.05 No significant

Discussion

Intensive care nurses have a fundamental role in the creation of safe and competent care for patients. ICU nurses are able to provide clear directions and guidance for procedures and routines, give continuous care, administer complicated medications, use several technological equipments, and offer care to patients in need of advanced life support. The patient safety culture is significant in terms of the representation of quality healthcare services. It includes all precautions and measures made for diminution or elimination of possible adverse effects of medical care during medical diagnosis and treatment. The most frequent problems threatening patient safety are diagnosis errors, medication errors, hospital infections, bedsores, complications during and after the operation, errors induced by the breakdown of equipment's-appliances, falls, and ventilator-related errors **(Ozata & Altunkan, 2016 and Fernández-Castillo, et al., 2021)**.

Concerning demographic characteristics of nurses under study, the results of the present study revealed that about two-thirds of the study nurses were females. This finding was in line with the findings of a study by **Tahoun, et al. (2021)** who conducted a study entitled "Nurses' application of international patient safety goals at accredited and non-accredited hospitals" found that at Benha University Hospital more than three-quarters of studied staff nurses' were females. These findings may be explained by the fact that nursing is a universal feminine profession, especially in Egyptian society culture as well as the enrolment of male students in this profession was started in the late decades.

Regarding age, more than two-thirds of the study nurses were between 25-35 years with a mean age of (29.28 ± 5.45) years. This result is consistent with results reported by **Wang, et al. (2019)** in a study entitled "A structural model of total quality management, work values, job satisfaction and patient-safety-culture attitude among nurses" who mentioned that about two- thirds of study subjects' age was between 25-35 years.

As well as, this result was supported by **Mamdouh, et al. (2020)**, in their study titled "Assessment of nurses' performance regarding the implementation of patient safety measures in intensive care units, at Kasralainy Hospital and **Salem et, al. (2019)**, in the study done at Damanhur University Hospital entitled "Nurses' perceptions of patient safety culture in intensive care units: A cross-sectional study" revealed that most of the studied nurses in the Intensive Care were in the age group 20-30 years, with a mean age of 30.4 ± 5.3.

As regards the nurses' educational level less than half of the studied nurses had technical nursing education, this finding is supported by **Mamdouh, et al. (2020)** who showed that less than half of the study nurses were nursing technical institute. This result

was contradicted by the study results of **Tahoun, et al. (2021)**, who noticed that the vast majority of the studied nurses' at Benha University Hospital had associate degrees in nursing. On the other hand, nearly three-quarters of them had a Bachelor of nursing science at Elaraby International Hospital.

Concerning years of experience and attending the training courses on patient safety standards, results of the current study indicate that two-fifths of the studied nurses had experienced (3 - < 5) years. Additionally, more than half of the nurses attend training courses related to general patient safety and the majority of them did not attend training courses related to Egyptian and WHO patient safety standards for hospitals. The results of the current study can be explained in the light of the belief that lack of hospital financial resources for training or shortage of nursing staff and work overload which considered a barrier for nurses to leave work and attend training courses.

This result was in agreement with the study results of **Salem, et al. (2019)** who revealed that two-fifths of the studied nurses had a nursing experience of 2-5 years and a minority of the enrolled nurses in the present study got training on patient safety. Additionally, This result was in the same line with the study results of **Tahoun, et, al. (2021)**, who cleared that more than half of the studied nurses had experienced less than 5 years at Benha University and Elaraby International Hospital respectively, and the majority of them at Benha University Hospital hadn't attended previous courses; on the contrary, the majority of them at Elaraby International Hospital had attended previous courses about patient safety.

In relation to the satisfactory level of nurses' knowledge regarding the Egyptian and WHO patient safety recommendations and solutions (Accurate standardized patient identification in all service areas, standardized process for dealing with verbal or telephone orders, handing critical values/tests, hand hygiene throughout the organization, prevention of catheter and tubing misconnections, prevention of patient's risk of falling, prevention of patient's risk of developing pressure ulcers, and a standardized approach to hand over communications) throughout pre/post and follow-up phases, The current study result revealed that the mean score of knowledge was improved at post-in-service training program implementation compared to before. Also, there were highly statistically significant differences between all items of knowledge for pre/post and post and follow-up phases at p≤0.001.

This result is supported by the study applied by Mahmoud, et al. (2022) titled "Effect of implementing nursing care protocol on critical patients' safety outcomes", who found that the total nurses' knowledge increased post nursing care protocol

implementation than before. Also, there were highly statistically significant differences between all items of knowledge at p ≤0.001.

This result is in agreement with the study done by **Shahin, et al. (2020)**, who conducted a study entitled "Quality of care and patients' safety awareness and compliance among critical care nurses at Qassim National Hospital" and indicated that critical care nurses have a high knowledge level regarding the patient identification in intensive care as mean-scores was (IPSG1, M= 0.960) and was related to the safety of high-alert medications (IPSG3, M= 0.963)

Concerning nurses' knowledge regarding Egyptian patient safety standards for hospitals throughout pre/post and follow-up phases displayed that more than half of the study nurses had an unsatisfactory score knowledge regarding dimensions of knowledge which includes (The Egyptian and WHO patient safety recommendations and solutions, standard general patient safety, standard medication safety, and preoperative and invasive procedure safety) at pre-implementation compared to after in-service training program implementation at follow-up phase, who had a satisfactory level of knowledge three months, with highly statistically significant differences for pre/post phases at p < 0.001.

These results match with the results of the study done by **Sloane, et al. (2019)**, who study "the effect of changes in hospital nursing resources on improvements in patient safety and quality of care" and revealed that a strong pattern for improvement in an education of nurses to be associated with improvements in quality of care and patient safety.

As well, **Abdelaal and Atalla (2020)** assess the effect of communication of physicians' verbal order educational awareness sessions on nurses' knowledge and safety attitudes and showed significant improvements in the overall nurses' knowledge regarding communication of physicians' verbal order along with the entire related dimensions immediately post and post three months from attending Verbal Order educational Awareness Sessions (VOEASs). Also, **Belal, et al. (2020)** in a study entitled "In-services education program for improving nurses' performance regarding infection control measures in a rural hospital" stated that the application of in-services educations used in the study had statistically significant improvement in nurses' knowledge and performance towards standards of infection control post-program implementation.

This result is similar to the result of the study done by **Mohamed, et al. (2019)** entitled "Effect of a training program on nurses' performance regarding care for patients under mechanical ventilator in intensive care units " stated that there were significant differences increase in total nurse knowledge score throughout the study. As well, **Seliem, et al. (2019)** in their study titled "Implementation of (Plan-Do-Check-Act) process of

quality and measuring its effect on nurses' practice of patient safety goals" revealed that there were improvements between pre and post-test in the participants knowledge regarding the patient identification, documentation of medications administration, infections control, and falling prevention.

Also, the study result is reinforced by **Abukhader and Abukhader (2020)** in a study titled " Effect of medication safety education program on intensive care nurses' knowledge regarding medication errors" which revealed that the educational program on medication safety improves the knowledge of critical care nurses regarding intravenous medication errors and recommend that medication errors should be periodically assessed by improving clinical guidelines of medication administration.

Additionally, **Khademian, et al. (2018)** in their study titled "Effect of training on the attitude and knowledge of teamwork among anesthesia and operating room nursing students: a quasi-experimental study" showed that the anesthesia and operating room nursing students' perceptions of communication dimension improved after Team STEPPS training. Also, this result agrees with, **Kreem & Hamza (2019)** who study "Effectiveness of educational program on nurses' knowledge regarding pre and post-operative nursing management" indicates that there is an improvement in the nurses' knowledge after the application of the education program.

Similarly, this study result sustained by **LeRose, et al.** (**2020)** evaluated the knowledge and practice of nursing staff towards infection control measures and "the impact of COVID-19 response on central-line–associated bloodstream infections and blood culture contamination rates at a tertiary-care center in the greater Detroit area" revealed that nearly more than one-quarter of the participants had a fair level of knowledge mainly due to deficiency of infection control training courses. The researchers explained this result was due to the similarity of shortage in programs and courses in most universities and nursing institutions and inadequate in-service training programs.

Concerning nurses' competent level of practice regarding factors of patient safety practice throughout pre/post and the follow-up phases validated that, there were improvements in the studied nurses' competent level of practice three months after an in-service training program implementation at the follow-up phase, with highly statistically significant differences between pre/post phases at $P < 0.001$. This can be explained by the statistically significant relationship between total practice and total knowledge pre/post-in-service training program.

This result was in agreement with **Mahmoud, et al. (2022)** who stated that total mean score of all practices was improved post-nursing care protocol implementation than

pre-implementation with highly statistically significant differences between all practices pre and post-implementation. Additionally, this result approves the study results of **Abdelmoaty et al. (2020)** in a study titled "Indwelling urinary catheter: Effect of training on nurses knowledge and skills" and revealed that there was a highly statistically significant difference between levels of acquired nurses' practices pre/post the interactive training.

Moreover, this finding is in agreement with **Mahmoud, et al. (2020)** who assessed the effect of educational programs on nurses' performance regarding infection control precautions, toward patients on mechanical ventilation and revealed that there was a statistically significant difference between before and after an educational program for patients on mechanical ventilation regarding total nurses' practice scores. Additionally, adequate performance infection controls standard precautions, increased after the application of education.

This result is in the identical line to **Seliem, et al. (2019)** who indicates that none or almost none of the nurses had adequate practice in any of the areas before the intervention. During the post-intervention phase, there were statistically significant improvements in all areas. The results also indicate that there was unsatisfactory practice related to infection control measures and environmental cleaning, and it was improved after program implementation.

These results match with the results of **EL-Shafey et, al. (2019)**   in their study titled "Effect of an Educational Training Program for Nurses about Infection Control Precautions in Their Practice in the Pediatric Critical Care" and revealed that there was a significant statistical improvement in practical skills after implementing the intervenes educational program to the nurses. As well he highly recommended periodic in-service, training for nurses about standard percussions & infection control measures, and keeping references related to infection control guidelines to be available for all nurse stations.

This was emphasized by, **Oliveira (2018)** who study "Multimodal strategy to improve the adherence to hand hygiene and self-assessment of the institution for the promotion and practice of hand hygiene" and stated that nosocomial infections may be transmitted to the patient by the nursing and healthcare providers who fail to practice or carry out the infection control measures.

Also, **Saad et, al. (2021)** in a study titled "Effect of an educational program on nurses' performance regarding reducing pressure ulcer and safety of immobilized patients" found that nurses' practices toward patient position, mobility, use of support devices, skin care, bed sheet care, and improvement in nutritional status and risk assessment improved significantly after implementation of the program. Likewise, Saleh, et al., **(2022)** who

assess the effect of educational programs on nurses' performance regarding safety infusion of look-alike sound-alike medication, revealed that the study subjects had performance deficits regarding safety infusion of look-alike sound-alike medications pre-educational programs then improved post-educational program implementation.

This study adheres with the study conducted by **Mahmood & Hassan (2020)** about "Effectiveness of an educational program on nurses' knowledge concerning the danger of mixing medications in Al-Hussein Teaching Hospital in Al-Muthana Governorate" and revealed that improvements have occurred in nurses' practices after applying suggested instructional program.

This finding is coherent with the study done by **Hassan, et al. (2022)** [47] titled "Web-based intervention improves surgical units nurses' performance about infection control precautions during coronavirus outbreaks" who indicated that more than one-third of the studied nurses had an incompetent level of practice pre-web-based intervention, whereas, post-web-based intervention most of them had a competent level of practice.

Additionally, **Ponce-Alonso, et al., (2020)** assessed the nurses' practice level regarding infection control measures during coronavirus disease and demonstrate that the majority of the study participants had good practice levels regarding infection control to be higher after the educational program than that what was reported before the intervention.

This result is match with **Montejano-Lozoya, et al., (2020)** [49] in a study titled "Impact of nurses' intervention in the prevention of falls in hospitalized patients" who stated that the systematic assessment of the hazard of a patient falling during the hospital practices has evidenced to be an effective involvement to decrease the occurrence of falls, especially in the elderly, who have the most falls. Therefore, it is necessary to implement specific advanced training for all nurses and not as a voluntary training program.

Regarding the comparison of mean scores among the study subject regarding the total level of nurses' knowledge and practice throughout pre/post phases and follow-up phases, the current study clarified that there were improvements of the studied nurses' satisfactory level of knowledge and competent level of practice at pre/post phases, respectively, with highly statistically significant differences between pre/post phases at ($P < 0.003$). This finding reflects that nurses' performance is based on their knowledge.

Finally, the study results revealed that there was a statically highly significant relationship between the total level of studied nurses' knowledge pre-test and practice for pre/post and follow-up at $P > 0.000$. While there was a highly statistically significant relationship between the total levels of studied nurses' knowledge post-test and practice for

pre-test and post-test phases at p < 0.014. Whereas there was a highly statistically significant relationship between the total levels of studied nurses' knowledge follow-up test and nurses' practice pre/post-test at p < 0.016.

This result supported by the study done by **Mamdouh, et al. (2020)** who showed a positive correlation and significant relation between total knowledge and total practice. **Mahmoud, et al. (2022)** also found that there was a highly significant positive correlation between total nurses' knowledge and their practice at pre and post-implementation of nursing care protocol where p < 0.001.

From researchers' point of view lack of nurses' information or misinformation may result in self-induced limitations that can undesirably affect ordinary day-to-day practices and patient safety. The current study results have brought out the gaps that exist in the nurses' knowledge and practical adherence which improved performance and the effect of having in-service training throughout the program implementation which optimizes their performance and getting maximum patient safety all over their day-to-day work.

Conclusion:

The present study results concluded that the current study supported the hypothesis of the study that there were highly statistically significant improvements in the mean scores of total knowledge and practice at the post and follow-up phases of the in-service training program implementation. Additionally, there were statistically significant differences in the relationship between the total level of studied nurses' knowledge and practice throughout pre/post and follow-up phases of in-service training program implementation

Recommendations:

Based on the findings of the current study, the following recommendations can be suggested:

- Future research is required to develop and enhance interventions to improve nurses' compliance with patients' safety and prevent further error.
- Develop and coordinate a multidisciplinary team approach to continuously evaluate nurses' performance regarding patients' safety standards.
- Develop systematically continuous in-service training programs for nurses graduated nurses to help improve their performance regarding patients safety

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الملخص العربى

تأثير برنامج التدريب أثناء الخدمة على أداء التمريض فيما يتعلق بمعايير ممارسات سلامة المرضى في وحدات العناية المركزة

المقدمة: يعد يعتير سلامة المرضى هو الهيكل الأساسي من حيث الثقافات والإجراءات والسلوكيات والتقنيات وإستمرار البيئة الأمنة للرعاية الصحية مما يؤدي إلي: تقليل المخاطر، وتقليل حدوث الضرر الذي يمكن تجنبه، وتقليل احتمال حدوث الأخطاء وتأثيرها عندما تحدث. و للتمريض دورًا حيويًا خاضعًا للرقابة في التأكيد علي سلامة المرضى بينما يقدموا الرعاية المباشرة للمرضى. **الهدف:** أجريت هذه الدراسة لتقييم تأثير برنامج التدريب أثناء الخدمة على أداء التمريض فيما يتعلق بمعايير ممارسات سلامة المرضى في وحدات العناية المركزة. **التصميم:** تم استخدام تصميم بحثي شبه تجريبي. **المكان:** أجريت الدراسة في أجريت الدراسة في وحدة العناية المركزة الرئيسية في المبنى الجراحي التابع لمستشفى جامعة عين شمس (الدمرداش). **العينة:** تم اختيار عينة هادفة من (65) ممرضاً وممرضاً يعملون في المكان المذكور سابقاً. **الأدوات:** (1) استبيان المقابلة يتكون من الخصائص الديموغرافية للتمريض واستبيان المعرفة، (2) قائمة الملاحظة العملية للتمريض بالرعاية المركزة. **النتائج:** تظهر تحسن في مستوى المعرفة التمريض ومستوى الممارسة والكفاءة لدي خلال مرحل ما قبل / وما بعد تنفيذ البرنامج والمتابعة، مع وجود فروق ذات دلالة إحصائية عالية بين ما قبل / وبعد تنفيذ البرنامج عند ($P < 0.003$). كما توجد علاقة ذات دلالة إحصائية عالية بين المستوى الإجمالي لمعرفة وممارسة التمريض محل الدراسة فيما قبل / وما بعد تنفيذ البرنامج والمتابعة عند ($P > 0.000$). **الخلاصة:** لقد أدى تنفيذ برنامج التدريب أثناء الخدمة إلى تحسن فعال في معرفة وممارسات التمريض فيما يتعلق بمعايير ممارسات سلامة المرضى في وحدات العناية المركزة خلال مراحل ما قبل / ومابعد تنفيذ البرنامج والمتابعة. **التوصيات:** تصميم وتنفيذ برامج تعليمية لتحديث المنتظم لمعارفة وممارسة التمريض فيما يتعلق بمعايير ممارسات سلامة المرضى في وحدات العناية المركزة.

مفاتيح الكلمات: التمريض، سلامة المرضى، برنامج التدريب أثناء الخدمة، معايير ممارسات سلامة المرضى.