

The Effect of Implementing Safe Injection Practice Educational Program on Knowledge And Risks Control Among Nurses In Intensive Care Units

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Background: Implementing safe injection practice creates the safest work environment for nurses working in intensive care units and minimizes exposure to risks. **Aim:** This study was carried out to evaluate the effect of implementing safe injection practice educational program on knowledge and risks control among nurses in intensive care units. **Setting:** study was carried out in cardiac care unit, medical, anesthesia, and neurological intensive care units at Tanta University Hospitals. **Design:** A quasi experimental study design was used in the present study. A purposive sample of 100 nurses who fulfilled the inclusion criteria were selected to achieve the aim of the current study. **Tool I: Sociodemographic, knowledge and nurses risk assessment structure questionnaire. Tool II: Safe injection practice observational checklist. Results:** All studied nurses had good total knowledge mean score level post program compare to only one quarter (25.0%) pre program. Also, positive statistically significant in total practice domains among the studied nurses post program compared to pre program p value <0.05 . **Conclusion:** The present study found that implementing educational program was highly effective in improvement of intensive care units nurses' knowledge and practice regarding safe injection and decline risks for both nurses and patients. **Recommendation:** use of safety engineered syringes and good waste management during injection procedures is necessary to decline risks and ensure safety among nurses in critical care settings.

Keywords: Safe injection practice, educational program, risks reduction, intensive care units.

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I. Introduction

Safe injection practice holds a sound position among nurses in Intensive Care Units (ICUs). Injection is the most common nursing procedures in ICUs that require a specific standard of safety. Therefore, injection should be given in a safe way to prevent harm risks for both critically ill patients and nurses⁽¹⁾.

Unsafe injection practice all over the world results in millions of serious infections, which may lead to dangerous diseases and deaths. According to World Health Organization (WHO) in (2010)⁽²⁾ the most recent statistics shows that the prevalence of unsafe injection alone worldwide is estimated to be 1.7 million subjects were infected with hepatitis B virus, 315.000 hepatitis C viruses and 33.800 human immunodeficiency virus (HIV) which lead to a high morbidity and mortality but it varies widely by country and by region.

Safe injection practice in ICUs is a set of recommendations within standard precautions, which are basis for preventing transmission of infections during critically ill patient care⁽³⁾. As defined by the WHO, a safe injection does not provide harm to the patient, does not expose the nurse to any avoidable risks and does not bring about dangerous waste. Unsafe injection practice put patients and nurse at risk of infectious and noninfectious adverse events and has been associated with a wide variety of procedures and settings⁽⁴⁾.

Unsafe injection practice in ICUs may be occurred due to lack of nurse's knowledge but are not limited to shared medications or reuse of syringes for multiple critically ill patients, administration of medication from a single dose vial to multiple critically ill patients and failure to follow aseptic technique during injections preparation and administration^(5,6).

Moreover, the harm risks of unsafe injection in ICU can be minimized through a planned educational program to improve nurses' knowledge and practice regarding safe injection practice as they form an important aspect of their occupational health. The primary focus of educational program that concerned with safe injection practice is to translate the information into effective implementation strategies to decrease risks among ICU nurses which include; how to secure work environment, maintain adequate staff to patient ratio, decrease the use of injection as possible, use of personal protective equipment, and conduct written policy regarding safe injection and proper handling of waste management to prevent breakdown of infection control^(5,7,8).

Significance of the study

The current study revealed that nurses experienced needle stick injury in the previous 6 months in ICU (44%) through recapping the needle (52%). The nurses did not know the place where post exposure prophylaxis was available if health professional have needle stick and sharp object injury (79%) using a common bag or bottle of intravenous solution to obtain a “flush” dose or for drug diluents for multiple patients (52%). Using the same syringe to reenter a multi-dose vial several times (65%) and reusing this vial for other patients (37%). Therefore, nurses working in ICUs should be aware about safe injection practice and standard precautions as they form an important aspect of their occupational health. Moreover, improvement of nurses' knowledge and practice regarding this aspect is important because correct practice helps in minimizing risks and ensures safety for critically ill patients and nurses.

1.1 Aim of the study: To evaluate the effect of implementing safe injection practice educational program on knowledge and risks control among nurses in intensive care units

1.2 Operational definition

Safe injection practice: Means implementing injection practice that does not expose both the nurse and patient to risks of injuries from injection or dangerous of handling wastes.

Safe injection practice educational program: includes teaching the nurses how to secure work environment, maintain adequate staff to patient ratio, use of personal protective equipment, and conduct written policy regarding safe injection and proper handling of waste management.

Risk control: Means a practical reaction that focuses on keeping both the patient and the nurse safe and minimizing risks or injury associated with higher risk behaviors. Regarding nurses; it means reduction of percutaneous injuries and other blood exposures through needle stick and sharp object injuries. In relation to patient; it means minimize patient's risks of injection such as extravasation and infection.

1.3 Research hypotheses:

H 1: The post program total knowledge mean score of ICU nurses regarding safe injection practice exhibit significantly higher than pre program total knowledge mean score.

H 2: The post program total practice mean score of ICU nurses regarding safe injection exhibit significantly higher than pre program total practice mean score.

H3: No evidence of risks among ICU nurses post implementing educational program compared to pre implementing program.

II. Method

2.1 Research design: A quasi experimental study design was used in the current study.

2.2 Study Setting: The study was carried out at Tanta University Hospitals ICUs which include cardiac care unit (CCU), medical, anesthesia, and neurological ICUs.

2.3 Study subjects

A convenience sample of 100 nurses working at CCU, medical, anesthesia and neurological ICUs at Tanta University Hospital were selected to attain the aim of the present study.

Inclusion criteria: Both sex, aged from 21- 60 years, provide direct patient care for critically ill patient and agreed to participate in the study.

2.4 Tools of the study:

Two tools were developed by the researchers after reviewing relevant literature and used to collect the data.

Tool I: Sociodemographic, knowledge and nurses risk assessment structure questionnaire^(9,10): This tool was developed by the researcher after reviewing a relevant literature. It consisted of three parts:

Part A: Nurses' sociodemographic and academic data⁽⁹⁾, to assess data related to age, sex, years of experience the nurse have in nursing field, years of experience the nurse have in the practice critical care areas, nurse to patient ratio, and previous training on safe injection.

Part B: Nurses' knowledge assessment^(1,10), to assess nurses' knowledge regarding safe injection such as hand washing techniques, wearing personal protective equipments, medication preparation, administration and handling wastes of injection. It consisted of 15 questions used to assess nurses' knowledge.

Scoring system: Each correct answer for true or false and multiple choice questions were given **one score** and the wrong answer were given **zero score**. The total knowledge score was 15. They were classified as: score less than 60% were considered as poor , score of 60% to less than 75% were considered as fair, and score more than 75% were considered as good.

Part C: Risk assessment ^(3,11), to assess risks occur for both the nurse and patients in relation to unsafe injection practice as the following:

Nurses' risk; the nurse experienced needle stick injury in the last six months, nurses activities leads to needle stick injury, types of needle stick injury sustained, frequency of needle stick injury in the last six months, Action taken immediately, transmission of infection and place where post exposure prophylaxis

Patient's risk; extravastion at the site of injection in the previous 2 weeks, action taken by the nurse, using bottle of intravenous solution to multiple patients, using the same syringe to re-enter a multi-dose vial several times and reusing a single dose vial for many patients.

Tool II: Safe injection practice observational checklist⁽¹²⁻¹⁴⁾ This tool was developed by the researcher after reviewing a relevant literature and used to assess nurses' practice related to safe injection practice and waste management. It included 34 steps divided into three observations as the following;

1. Behavioural changes for safe injection: It included 11 items that covered the practice of nurses regarding safe injection.

2. Supplies and equipment needed for safe injection practice: It consisted of 15 items that allow the nurse to perform safe injection procedure effectively.

3. Sharp wastes management activities for safe injection: It included 8 items regarding segregation and collection of wastes to complete safe injection.

Scoring system: **Three** were allotted for proficiently performed step, **two** score for competently performed step, **one** score for incompletely performed step and need improvement, and **zero** score was given to incorrect or not done step.

The total practice score was 34. The higher score indicated higher level of practice. They were classified as: < 60 % were considered as poor, from 60 % to < 75% were considered as satisfied, and > 75% were considered as good practice level.

2.5 Ethical consideration:

- Official permission to carry out the study was obtained from the director of Tanta University Hospital before conducting this study.
- Nurses' formal consent to participate in the current study was obtained and he/she had the right to withdraw from the study at any time without any rationale. Confidentiality of each nurse was determined through coding of all data.

2.6 Validity and reliability:

1. All tools of the study were developed by the researchers after reviewing relevant literature and used to collect the data.
2. All tools were programed for content validity by three panels of experts in the field of critical care nursing, Faculty of Nursing, Tanta University, and two experts in Medical Biostatistics and Microbiology, Faculty of Medicine, Tanta University and modifications were done accordingly to ensure their validity.
3. All tools of the study were programed for reliability and Cronbach alpha was used and found to be 0.875 and 0.898 respectively for tool I and II which represent highly reliable tools.

2.7 A pilot study

- A pilot study was conducted on 10 nurses in order to program the clarity, achievability and the applicability of the different items of the developed tools. Modifications of tools were done accordingly. Those nurses were excluded from the study sample.
- Data collection for the study was carried out for a period from the end of October 2017 until the end of April 2018.

2.8 The educational program

The educational program was carried out on 4 phases (assessment, planning, implementation and evaluation)

A. The assessment phase:

Intensive care nurses who agreed to participate in this study and fulfilled the inclusive were selected and assessed at the beginning of the study. The assessment was collected pre implementation of the educational program as a baseline data as follows:

1. Assessment of nurses' knowledge regarding safe injection practice as hand washing techniques, wearing personal protective equipments, medication preparation and administration and handling wastes of injection using tool I part B.
2. Assessment of nurses' practice regarding safe injection such as identifying behavioural changes, needed supplies and equipments and sharp wastes management activities using tool II.

3. Assessment of nurses' and patients' risks related to unsafe injection practice using tool I part C.

A. The planning phase:

This phase was structured based on assessment phase and literature review^(11,13,14). Priorities and expected outcome criteria should be put into consideration when planning for nurses' safe injection practice.

Expected outcomes include:

- Enhancing the total knowledge mean score of ICU nurses regarding safe injection practice
- Increasing the total practice mean score of ICU nurses regarding safe injection
- No evidence of risks among ICU nurses

The program was developed and translated by the researchers based on ICU nurses assessment to achieve the aim of the study. Each nurse took about 30-40 minutes to fulfill the tools of the study.

In this phase also educational videos, a power point was developed. It devolved in a simple Arabic language and supplemented by illustrations to help the nurses understanding the content. The researchers selected teaching methods which were lectures, small group discussion, and problem solving situations.

B. The implementation phase:

An educational program was carried out for all nurses in educational class room at Tanta University Hospital. The educational program consisted of 5 sessions: two sessions were conducted for two consecutive days for the theoretical part and three sessions were conducted for other three consecutive days for practical part. Every session took approximately two hour. The teaching program was conducted in small groups (4-5 nurses /session).

For the theoretical part: two sessions were used as follows; **session one** of the teaching program consisted of study aim, rationales and benefits of the study for using safe injection. **Session two** consisted of handling and disposal of wastes. Each nurse was supplemented with printed materials of power point. During the session, nurses were encouraged to ask questions and provide feedback. Teaching methods utilized were lectures, group discussions, and demonstrations.

For the practical part: three sessions were used following theoretical sessions as follow; **Session one** included techniques of safe injection. **Session two** included maintain nurse's safety practice during injection. **Session three** consisted of allowed and prohibited injection practices. The practical part was carried out in the same lecture room. Demonstration and redemonstration was done. The teaching media used in the study was consisted of educational videos, and problem solving situation.

C. The evaluation phase:

All nurses were evaluated two times by using tool I and II pre and post implementing teaching program.

Regarding theoretical part, each nurse was post implementing educational program to answer the structured questionnaire (tool I) and the time taken was 30 to 40 minutes to fill out the questionnaire.

In relation to practice, each nurse was observed individually three times in three different shifts in the ICUs post implementing educational program to evaluate the safe injection practice regarding behavioral changes, needed supplies and equipments and sharp wastes management activities using Safe injection practice observational checklist (tool II). It took an average of 30 to 40 minutes for the procedure to complete.

2.9 Limitation of the study

The results of this study cannot be generalized to all ICUs, because the result was only representative to this hospital.

2.10 Statistical analysis

Data was collected then tabulated and statistically analyzed using statistical software package of social studies (SPSS) software statistical computer package version 19. For quantitative variables, the mean and standard deviation were calculated. For qualitative categorical variables, the frequencies and percentage was calculated. Statistical significance of the teaching program was adopted at $p < 0.05$ for interpretation programs of significance⁽¹⁵⁾.

III. Results

Table (1): Percentage distribution of studied nurses according to sociodemographic characteristics

Characteristics	The studied nurses (No =100)	
	No	%

Age (in years)		
▪ < 30 years	51	51.0
▪ 30-40 years	49	49.0
Sex		
▪ Male	2	2.0
▪ Female	98	98.0
Educational level		
▪ Diploma	8	8.0
▪ Associated degree	46	46.0
▪ Baccalaureate degree	42	42.0
▪ Post graduate	4	4.0
ICU work		
▪ Cardiac ICU	24	24.0
▪ Medical ICU	44	44.0
▪ Anesthesia ICU	15	15.0
▪ Neurological ICU	17	17.0
Experience (in years)		
▪ < 5 years	2	2.0
▪ 5-10 years	55	55.0
▪ > 10 years	43	43.0
Experience in ICU (in years)		
▪ < 5 years	38	38.0
▪ 5-10 years	38	38.0
▪ > 10 years	24	24.0
Nurse / patient ratio		
▪ 1:1	49	49.0
▪ 1:2	33	33.0
▪ 1:3	18	18.0

Table (1) shows percentage distribution of studied nurses according to sociodemographic characteristics. The results revealed that more than half (51.0%) of studied nurses were in the age group of less than 30 years while, 49.0% were in the age group of 30 to 40 years. Vast majority (98.0%) of studied nurses were females, while only 2.0% were males.

Regarding ICU work, less than half (44.0%) of studied nurses' work in medical ICU compared to (24.0%, 15.0% and 17.0% respectively) work in cardiac, neurological and anesthesia ICU.

As regards to years of experience, more than half (56.0%) of the studied nurses had 5-10 years of experience in the field of nursing while, less than half (43.0%, and 2.0% respectively) had more than 10 years and less than 5 years. Additionally the same percentage (38.0%) of studied nurses had less than 5 years and 5-10 years of experience in ICU.

In relation to nurse to patient ratio, nearly half (49.0%) of studied nurses had 1:1 nurse to patient ratio compared to (33.0% and 18.0% respectively) had 1:2 and 1:3 nurse to patient ratio.

Table (2): Percentage distribution of studied nurses according to safe injection practice in ICU

Safe injection practices	The studied nurses (n=100)	
	N	%
Nurses training program about safe injection practice		
▪ Yes	87	87.0
▪ No	13	13.0
Commonly used hand washing materials		
▪ water and plain soap	66	66.0
▪ Alcohol hand rub	18	18.0
▪ water only	3	3.0
▪ water and povidone-iodine 7%	13	13.0
Written policy and procedure regarding safe injection practice		
▪ Yes	55	55.0
▪ No	45	45.0
Adequate waste management activities		
▪ Present	93	93.0
▪ Absent	7	7.0
Types of sharp equipments		
▪ Plastic bag	68	68.0
▪ Safety box	16	16.0
▪ Both plastic bag & safety box	16	16.0

Table (2) reveals percentage distribution distribution of studied nurses according to safe injection practice in ICU. It can be seen that the majority (87.0%) of studied nurses had training program regarding safe injection in ICU while, the minority (13.0%) of studied nurses had no training program. In relation to commonly

used hand washing material, nearly two thirds (66.0%) of studied nurses washed their hands using water and plain soap compared to (18.0%, 13.0% and 3.0% respectively) using alcohol hand rub, povidone iodine 7% and water only.

Regarding written policy and procedure for safe injection practice, more than half (55.0%) of studied nurses had written policy and procedures about safe injection practice compared to 45.0% had no written policy and procedures. Regarding adequate waste management activities, vast majority (93.0%) of studied nurses carried out adequate waste management activities while, the minority (7.0%) were not carried out adequate waste management activities. Additionally, more than two-thirds (68.0%) of studied nurses used plastic bags to get ride of sharp equipments of injection compared to 16.0% used safety box and open container.

Table (3): Percentage distribution of the studied nurses in relation to risks of unsafe injection practice

Risks of unsafe injection for studied nurses	The studied nurses (No =100)	
	No	%
1.Are you experienced needle stick injury in the previous 6 months in ICU	44	44.0
▪ Yes	56	56.0
▪ No		
2. If yes, which activity resulting in needle stick injury	n=44	
▪ Recapping the needle	23	52.3
▪ work load	13	29.5
▪ sudden movement of the patient during procedure	5	11.4
▪ Lack of experience	3	6.8
3. Types of needle stick injury sustained	21	47.7
▪ Deep injury	23	52.3
▪ Superficial injury		
4. How many times needle stick injury did you sustained in the last 6 months	33	75.0
▪ One times	11	25.0
▪ two times		
5. Action taken immediately when needle stick injury occurred	29	65.9
▪ Hand washing	15	34.1
▪ Vaccination against HBV		
6. Do you think that used needles /sharps injuries can transmit diseases?	44	100.0
▪ Yes		
7. Do you know the place where post exposure prophylaxis is available if health professional have needle stick and sharp object injury?	9	20.5
▪ Yes	35	79.5
▪ No		

Table (3) illustrates percentage distribution of the studied nurses in relation to risks of unsafe injection practice. It was observed that approximately half (44.0%) of studied nurses were experienced needle stick injury in the previous 6 months compared to 56.0% were not experienced needle stick injury. Moreover, the most common (52.3%) activity resulting in needle stick injury among studied nurses was recapping the needle while, the least common (6.8%) activities was lack of experience.

Moreover, three-quarters (75.0%) of studied nurses had one time needle stick injury in the last 6 months while, the remaining quarter (25.0%) of studied nurses had two times. Nearly four-fifth (79.5%) of studied nurses were not known the place where post exposure prophylaxis is available post needle stick and sharp object injury compared to 20.5% of studied nurses were known the place of prophylaxis.

Table (4): Percentage distribution of the studied nurses in relation to risks of unsafe injection practice for the patients

Risks of injection practice for patients	The studied nurses (n=100)	
	No	%
a-Extravastion at the site of injection:		
1.Are you experienced extravastion at the site of patient injection during injection in the previous 2 weeks		
▪ Yes	49	49.0
▪ No	51	51.0
2. If yes, clarify the cause of it	n = 49	
▪ Improper insertion of the needle	34	69.4
▪ irregular follow up the patients infusion	15	30.6

3.Action taken when extravasation occurred:		
▪ apply cold compresses	28	57.1
▪ Try to aspirate the infusion	18	36.7
▪ Notify the physician	3	6.1
b- Infection at the site of injection:		
1.Are you experienced infection at the site of injection during patient injection in the previous 2 weeks		
▪ Yes	24	24.0
▪ No	76	76.0
2.If yes, clarify the cause of it	n = 24	
▪ Extravasation	17	70.8
▪ Abscess formation	2	8.3
▪ Improper injection	5	20.8
3.Action taken when infection occurred		
▪ apply cold compresses	20	83.3
▪ Notify the physician	4	16.7
4-Using a common bag or bottle of intravenous solution to multiple patient		
▪ Yes	52	52
▪ No	48	48
5-Using the same syringe to re-enter a multi dose vial several times		
▪ Yes	65	65
▪ No	35	35
6-reusing a single dose vial for other patients.		
▪ Yes	37	37
▪ No	63	63

Table (4) reveals percentage distribution of the studied nurses in relation to risks of unsafe injection practice for the patients. It can be seen that slightly less than half (49.0%) of studied nurses were experienced extravasation at the site of patients injection during injection in the previous 2 weeks while, 51.0% studied nurses were not experienced extravasation at the site of patients injection. The most common cause of extravasation at the site of patient injection (69.4%) was improper insertion of the needle while, the least common cause (10.2%) was irregular follow up the patients infusion. The most common (57.1%) action taken by the studied nurse when extravasation at the site of patients injection occurred were application of cold compresses on the extravasation site while, the least common cause (6.1%) was notify the physician.

In relation to infection at the site of injection, nearly fourth (24.0%) of studied nurses were experienced infection at the site of patients injection during injection in the previous 2 weeks while, the remaining three fourths (74.0%) studied nurses were not experienced infection at the site of patients injection. The most common cause of infection at the site of patient injection (69.4%) was extravasation while, the least common cause (12%) was abscess formation. The most common (69.4%) action taken by studied nurse when infection at the site of patients injection occurred were application of cold compresses on the infection site while, the least common cause (16.7%) was notify the physician.

Table (5): Percentage distribution of the studied sample in relation to their total knowledge mean score pre post implementation of the program

Total Knowledge level	The studied nurses (No=100)				χ ² P
	Pre program		Post program		
	No	%	No	%	
▪ unsatisfactory	16	16.0	0	0.0	120.0 0.00*
▪ satisfactory	59	59.0	0	0.0	
▪ Good	25	25.0	100	100.0	
Range	(5-13)		(13-15)		Z=8.72 P=0.00*
Mean ± SD	10.06±1.62		14.89±0.35		

<9 unsatisfactory 9-11.25 satisfactor >11.25 Good
 Z: Wilcoxon Signed Ranks Program * Significance at P < 0.05.

Table (5) illustrates percentage distribution of the studied nurses in relation to their total knowledge mean score pre and post implementation of the program. It was observed that one quarter (25.0%) of studied nurse had good total knowledge score pre program compared to 100.0% the studied nurses had good total knowledge level post program. The difference was statistically significant among the studied nurses pre post program p value < 0.05.

Table (6): Percentage distribution of the studied nurses in relation to total practice domains pre post program

Total practice domains	The studied nurses (n=100)
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	Pre program	Post program	χ^2 P
	Range Mean \pm SD	Range Mean \pm SD	
1.Total behavioral changes domains	(3-10) 6.62 \pm 2.15	(8-11) 10.24 \pm 0.67	Z=8.282 P=0.00*
2.Total equipments and supplies domains	(4-15) 10.71 \pm 3.17	(13-15) 14.88 \pm 0.38	Z=8.59 P=0.00*
3.Total sharp wastes management process domains	(2-7) 5.98 \pm 1.06	(6-8) 7.39 \pm 0.51	Z=8.71 P=0.00*

FE: Fisher's Exact Program Z: Wilcoxon Signed Ranks Program

* Significance at P < 0.05.

Table (6) shows percentage distribution of the studied nurses in relation to total practice domains pre post program. The results indicated that there were positive statistically significant increase were observed regarding total behavioral changes domains, total equipments and supplies domains and total sharp wastes management process domains among the studied nurses post program compared to pre program p value >0.05.

Table (7): Percentage distribution of the studied nurses in relation to their total practice mean score pre post implementation of the program

Total performance level	The studied nurses (No=100)				χ^2 P
	Pre program		Post program		
	No	%	No	%	
▪ Poor	30	30.0	0	0.0	91.971 0.00*
▪ Satisfied	33	33.0	0	0.0	
▪ Good	37	37.0	100	100.0	
Range Mean \pm SD	(11-31) 23.31\pm5.47		(30-34) 32.51\pm0.98		Z=8.691 P=0.00*

<20.4 Poor 20.4-25.5 Satisfied >25.5 Good

Z: Wilcoxon Signed Ranks Program * Significance at P < 0.05.

Table (7) reveals percentage distribution of the studied nurses in relation to their total practice mean score pre post implementation of the program. It was observed that (30.0%, 33.0% and 37.7% respectively) of studied nurse had poor, satisfied and good total practice score pre program. While, all of the studied nurses had good total practice score post program. The difference was statistically significant among the studied nurses pre post program p value < 0.05.

Table (8): Comparison between total knowledge level and total practice level among the studied nurses' pre post implementation of the program

Total practice level		The studied nurses (No=100)						χ^2 P
		Total knowledge level						
		Unsatisfactory		Satisfactory		Good		
		n	%	n	%	n	%	10.32 0.04 *
Pre program	Poor (n=30)	9	56.3	14	23.7	7	28.0	
	Satisfied (n=33)	2	12.5	19	32.2	12	48.0	
	Good (n=37)	5	31.2	26	44.1	6	24.0	
Total		16	100.0	59	100.0	25	100.0	
Post program	Good (n=100)	0	0.0	0	0.0	100	100.0	-
Total		0	0.0	0	0.0	100	100.0	

* Significance at P < 0.05.

Table (8) reveals comparison between total knowledge level and total practice level among the studied nurses' pre post implementation of the program. Regarding total knowledge score, It was found that more than half (56.0%) of studied nurses had poor knowledge and practice compared to approximately one-third of studied nurses had good knowledge and practice pre program. While, all of the studied nurses (100.0%) had good total knowledge and practice score post program. It can be seen that there were statistical significant differences among studied nurses pre post program in relation to total knowledge and practice p < 0.05.

Table (9): Correlation between total knowledge and practice score and sociodemographic characteristics among the studied nurses' pre post implementation of the program

Sociodemographic Data	Total knowledge score				Total practice score			
	Pre program		Post program		Pre program		Post program	
	r	P	r	P	r	P	r	P
Age (in years)	0.130	0.198	0.069	0.49	0.064	0.526	0.001	0.988

				3				
ICU work								
1.Cardiac ICU	0.386	0.00**	0.044	0.66	-0.328	0.001**	-0.351	0.00*
2.Medical ICU	0.005	0.964	0.044	0	0.183	0.068	0.177	*
3.Anesthesia ICU	0.099	0.325	0.045	0.66	0.367	0.00**	0.094	0.078
4.Noeuro.ICU	-0.338	0.001*	0.151	6	-0.218	0.029*	0.076	0.352
		*		0.65				0.454
				8				
Experience (in years)	0.198	0.049*	-	0.23	0.229	0.022*	0.107	0.287
			0.121	1				
Experience in ICU (in years)	0.167	0.097	0.112	0.26	0.068	0.500	-0.032	0.752
				5				
Nurse to patient ratio	0.122	0.227	0.136	0.17	0.144	0.154	0.046	0.651
				7				
Training of ICU nurses about safe injection	-0.359	0.00**	0.067	0.50	0.120	0.236	0.128	0.204
				5				
Total Practice score	-0.107	0.289	0.048	0.63	-			
				5				

* Correlation is significant at P<0.05. ** Correlation is highly significant at P<0.01.

Table (9) illustrates correlation between total knowledge and practice score and sociodemographic characteristics among the studied nurses' pre post implementation of the program. Regarding total knowledge score, It was noticed that there was a highly positive significant correlation in relation to cardiac ICU and total knowledge pre program $r= 0.386$ and $p=0.00**$ compared to post program. However, a negative and significant correlation was observed regarding medical ICU and total knowledge score $r=-0.338$ and $p=0.001**$ compared to post program.

In relation to total practice score, a negative and significant correlation was observed among cardiac ICU pre and post program ($r= -0.328$, $p=0.001**$ and $r= -0.351$ and $p=0.000**$ respectively). Positive correlation was observed among anesthesia ICU pre program. On the other hand, a negative and significant correlation was observed among neurological ICU pre program $r= -0.218$, $p=0.029*$.

Regarding age, no significant correlations were observed regarding age in relation to total knowledge and practice pre and post program.

As regards to nurses' experience, significant correlation was observed among studied nurses regarding nurses' experiences in relation to total knowledge and total practice pre program with $p= 0.049$ and 0.022 respectively. This means that nurses with more years of experiences had high total knowledge score.

Regarding previous training in ICU, a negative and significant correlation was observed pre program regarding total knowledge score with r and $p=-0.359$ and $0.00**$ respectively.

IV. Discussion

Safe injection practice is a part of standard precautions which include a set of recommendations that play a great role in preventing transmission of infections during patient care. Unsafe injection practice put patients and nurse at risk of infection especially blood borne infections like hepatitis B, hepatitis C and HIV, the most common route of transmission of blood borne pathogens being accidental injury by contaminated needles. (16-18)

In relation to sociodemographic characteristics of critical care nurses, the present study revealed that more than half of critical care nurses were in the age group of less than 30 years old. This result was congruent with Zhang et al (2016)⁽¹⁹⁾, they found that the majority of studied nurses in ICU were in the age group of 20-30 years old.

Regarding sex, the current study illustrated that the majority of critical care nurses were females. This result was in line with Zhang et al (2014)⁽¹⁹⁾, they found that the majority of studied nurses in ICU were female.

As regards to training of ICU nurses about safe injection practice, the current study revealed that the majority of studied nurses had previous training program regarding safe injection in ICU. The fact is that Tanta University Hospital had infection control committee which was responsible for nurses' inservice training program but this committee had obstacles in certain areas. This finding contradicted by Fashafsheh et al (2015)⁽²⁰⁾, they found that nearly two thirds of studied nurses had not previous training on infection control

Regarding waste management activities, it was found that vast majority of studied nurses carried out adequate waste management activities. It may be due to the nurses were anxious to stick themselves or other health care worker This findings was contradicted with Gadzama et al (2014)⁽²¹⁾, they found that the hospital wastes was not collected and disposed of according to the standard waste management guidelines which include wastes segregation, storage and transporting.

Concerning risks of unsafe injection practice for nurses, approximately half of studied nurses were experienced at least one needle stick injury in the previous 6 months and the most common activity resulting in needle stick injury among studied nurses was recapping the needle and the injury was superficial. This may be due to stressful situations and working under hectic pace to save the patients' life put the critical care nurse at a higher risk for needle stick injury. So the critical care nurses were in need for further risk prevention measures.

This finding was going with **the International Healthcare Worker Safety Center (2011)⁽¹¹⁾**, which proposed that the largest proportion of percutaneous injuries among ICU nurses were caused by disposable syringes. In addition, Logez et al (2004)⁽²²⁾, mentioned that more than two thirds of health care workers was experienced at least one needle-stick injury in the previous 12 months. Also, Lori et al (2016)⁽²³⁾ stated that over one third of nurses reported four or more sharps injuries in the past 12 months which enable them to acquire serious infection. Additionally, Sharma et al (2010)⁽²⁴⁾ clarified that recapping of needles after use was the most common cause of needle stick injury among the studied nurses.

Regarding to risks of unsafe injection for patients, approximately half of studied nurses used a common bag or bottle of intravenous solution to multiple patients. It may be related to the nurses' misperceptions that they could maintain a safe patient environment through using a clean syringe every time of injection and discard the intravenous solution after 24 hours. This result was inline with Pugliese et al (2010)⁽²⁵⁾, they showed that the nurse used intravenous solution bag to fill flush syringes for more than one patient

The present study illustrated that more than two third of nurses used the same syringe to re-enter a multi dose vial several times and more than one third reused a single dose vial for other patients. This finding was congruent with Pugliese et al (2010)⁽²⁵⁾, they stated that the nurse express a misunderstanding about the difference between multi dose vials and single-use.

In relation to total knowledge score level, the present study reported that a statistical significant improvement was observed among the studied nurses pre and post implementation. This may be due to the lack of counseling of the critical care nurse. This finding was inline with Fashafsheh et al (2015)⁽²⁰⁾, they illustrated that there was a statistical significant difference in relation to total knowledge score of safe injection practice among the studied nurses. Also, Pugliese et al (2010)⁽²⁵⁾, found the majority of nurses had misperceptions regarding safe injection practices and decrease in knowledge score.

Concerning total practice score level, the present study reported that a significant and statistical improvement was noticed among the studied nurses pre post implementation of the program. This result was incongruent with the result of Fashafsheh et al (2015)⁽²⁰⁾, they demonstrated that there was no statistical significant difference in practice scores among the studied nurses.

As regards to correlations between years of experiences and total knowledge and practice score, the result of the current study revealed that a significant correlation was observed among studied nurses regarding nurses' experiences in relation to total knowledge and practice score. This result was incongruent with Gijare (2012)⁽²⁶⁾, who found that there was no significant statistical difference in pre post program knowledge and practice scores in relation to different years of experience. Also, Hamid et al (2010)⁽²⁷⁾, reported no relationship between knowledge or practice score regarding factors such as age and years of experience among the studied group.

V. Conclusion

In conclusion, the current study revealed that the most common risk results from unsafe injection practice among nurses working in ICUs was needle stick injury. Also, implementing educational program was highly effective in improvement of ICU nurses knowledge and practice mean score regarding safe injection. Moreover, all nurses had good knowledge and practice post educational program. Therefore, correct practice helps in minimize and eliminate risks and ensure safety for both critically ill patients and nurses.

VI. Recommendation

Based on the present study findings it is recommended that:

1. Use of safe injection practice such as using safety engineered syringes and good waste management during injection procedures is necessary to decline risks and ensure safety among nurses in critical care settings.
2. Frequent training of the critical care nurses regarding infection control and safe injection practice is essential to improve nurses' knowledge and practice.

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