

Effect of Educational Program on Nurses' Performance regarding Infection Control in Labor and Delivery Care Units

Marwa Ali Shehab El-Din¹, Azza Fouad El-Adham², Shimaa Mohamed Hashem³

¹ Bachelor in nursing science; Faculty of Nursing El-Mansoura University, Egypt.

² Assist. Prof. of Maternal and Neonatal Health Nursing Dept., Faculty of Nursing, Tanta University, Tanta, Egypt.

³ Lecturer at Maternal and Neonatal Health Nursing Dept., Faculty of Nursing, Tanta University, Tanta, Egypt.

Abstract

Background: Prevention of infection is a challenge for health-care systems, especially at labor and delivery care units. **The aim of this study** was to evaluate the effect of educational program on nurses' performance regarding infection control at labor and delivery care units. **Subjects and method: Design:** A quasi-experimental research design. **Setting:** Labor and delivery care units of Tanta University, as well as El-Menshawy and Zefta General Hospitals, and Al-Santa Central Hospital. **Subjects:** All available nurses (170) working at the previously mentioned settings were included. **Tools for data collection: Tool (I): Structured Interview Schedule for Nurses** that included socio-demographic characteristics, and nurses' knowledge regarding Infections Control. **Tool (II): Infection Control Observation Checklist** that included items related to nurses' practice, and to labor and delivery care units. **Results:** There is a statistically significant effect of the educational program on nurses' performance regarding infection control at labor and delivery care units. **Conclusion and recommendations:** Nurses' performance regarding infection control at labor and delivery care units significantly improved due to the educational program. Thus, conduction of in-service training programs at labor and delivery care units is important to enhance nurses' performance.

Key words: Educational Program, Nurses' Performance, Infection Control

Introduction

Infection prevention and control (IPC) is described as the policies and procedures that should be undertaken to control and decrease the spread of infection at labour and delivery care units. ^[1,2] Hospital-acquired infection (HAI) refers to infections that are not present at the time of admission to a hospital or other health care institution. Nosocomial infections (NIs) and healthcare-associated infections (HCIs) should be avoided by all health care providers, particularly maternity nurses. ^[3,4] The prevalence of HAI according to the most recent estimates is 15.5 per 100 patients.

According to the World Health Organization (WHO), 7.1 million cases of HAI occur every year; one in every 20 people is suffering from HAI. Sepsis constitutes around 10.0% of all maternal deaths and leads to 99,000 cases of death per year. This imposes an annual cost of \$32 million to the society, which has a financial burden on the direct costs of the hospital related to prolonged stay and readmission, as well as costs to the community and the patients themselves. ^[5] Hospital-acquired infection (HAI) is a major health problem for pregnant women's due to cell-mediated immunity changes. Sepsis

continues to be a primary cause of avoidable maternal death despite advancements in health care and worldwide efforts to reduce maternal mortality. Infection may occur at labour and delivery care facilities for a variety of reasons or factors such as employees, processes, equipment, the environment and others.^[6,7]

These were categorized into six major categories, which are poor practices due to lack of awareness about infection causes and prevention among the staff, direct and indirect lack of staff adherence to infection prevention and control (IPC) guidelines throughout the maternity care, host of environmental factors as lack of sterilization of warmers at labour rooms in accordance with hospital infection control policies.^[8] Moreover, patients' risk factors for infection such as home delivery, extended labour with or without membrane rupture, numerous vaginal examinations, obstetric procedures, retained placenta, postpartum hemorrhaging, patient's age, number of children, and history of other co-morbidities pre-existing medical disorders as fever or antibiotic therapy two weeks before to labour and delivery care units, operational vaginal deliveries, endometritis and neonatal sepsis are other reasons.^[9,10]

Complications of HAI after childbirth include increase maternal death and morbidity, particularly in under-resourced countries. Infections such as hepatitis B (HBV), hepatitis C (HVC), and human immunodeficiency viruses (HIV) may occur during childbirth, as well as severe acute respiratory syndrome coronavirus 2 (SARS-CoV2).^[11,12] These illnesses may be prevented or managed by preventing pathogens from entering and growing in the body, better treatment during childbirth and immediate post-partum care may save up to 1.49 million maternal and

infant deaths and stillbirths over the world, as well as hand hygiene.^[5]

Moreover, best practices (pre/intra/postnatal) of infection control measures at labour and delivery care units should also be used such as the use of personal protective equipment (PPE), injection safety, the handling of patients' possessions, and cleaning and sanitizing the surrounding environment and/or correct aseptic technique, wearing gloves all times throughout labour, and a gown, a mask, and eye protection at all times during procedures. Patients with a high risk of infection should get antibiotic prophylaxis at 4-hour intervals during vaginal delivery.^[13,14] In addition to using a disinfectant during vaginal exams, anti-tetanus prophylaxis should be administered in the event of a birth outside of a hospital or an unsafe abortion. Chlorhexidine should be used to clean the post-delivery cord stump in situations when there is a high risk of infection.^[1,2]

Thus, nurses have a critical role in preventing and controlling infections in the workplace. Thus, it is critical that nurses at labour and delivery care units undertake infection control education programs for their nurses in order to improve their performance.^[15,16]

Significant of the study

Nurses have a pivotal role in infection control and prevention. They must be up-to-date in their knowledge and practices^[3]. So, it is very important to implement infection control educational program for nurses at labor and delivery care units to enhance and improve their performance.

The aim of this study was to

Evaluate the effect of educational program on nurses' performance regarding infection control at labor and delivery care units.

Research Hypothesis

Nurses' performance is expected to be improved after implementation of the educational program regarding infection control at labor and delivery care units.

Subjects and Method

Study design

A quasi experimental research design was used to conduct this study.

Setting

The study was conducted at the labor and delivery care units of Tanta University Hospital affiliated to Ministry of High Education, as well as El-Menshawy General Hospital, Al-Santa Central Hospital and Zefta General Hospital affiliated to Ministry of Health and Population

Subjects

All available (170) nurses who were working at the previously mentioned settings during time of the study were included and classified as follows: Tanta University Hospital: 44 nurses, El-Menshawy General Hospital: 34 nurses, Al Santa Central Hospital: 38 nurses and Zefta General Hospital: 54 nurses.

Tools of data collection

To achieve the aim of the present study two tools were used as follows:

Tool I: Structured Interview Schedule for Nurses:

It was developed by the research after reviewing recent related literatures and included the following two parts:

Part (1):Socio-Demographic Characteristics of the nurses:

It included nurses' age, gender, marital status, place of residence, education, years of experience, work setting and previous training regarding infection control at labor and delivery care units.

Part (2): Nurses' Knowledge regarding Infections Control:

It was developed by the researcher after reviewing recent literature [3, 17, 18,19,20,21] to assess the nurses' knowledge regarding infection control at labor and delivery care units before and after implementation of the educational program. It included questions related to definition of infection; causes; factors that increase the possibility of infection; sources of infection, definition of hospital acquired infection; common types; methods and chain of transmission; complications for a woman and her newborn baby; and ways to prevent infection for mothers and newborns at labor and delivery care units. It also included questions related to definition of standard precautions; standard infection control precautions and procedures for nurses at labor and delivery care units; and for the environment.

Scoring system for knowledge

- Correct and complete answers were scored as (2).
- Correct and incomplete answers were scored as (1).
- Incorrect answers and didn't know were scored as (0).

The total score for knowledge was calculated as follows:

- High level of knowledge $\geq 80\%$.
- Moderate level of knowledge $65 < 80\%$.
- Low level of knowledge $< 65\%$.

Tool II: Infection Control Observation Checklist:

It was developed by the research after reviewing recent related literatures [3,19,21, 22,23,24,25] and included the following two parts:

Part (1): Infection Control Observation Checklist for Nurses' Practice

This part was used to assess nurses' practices of infection control procedures at labor and delivery care units before and after implementation of the educational program. It included questions related to: Maintaining hand hygiene; having and removing personal protective equipment (eye glasses, mask, cap, gown, apron, overshoes, boot); doing and removing the surgical gloves; safely collecting and disposing waste (Sharps, handling needle stick injuries, waste disposal, linen)

Scoring system of practice

- Done correctly and completely was scored as (2).
- Done correctly but incompletely was scored as (1).
- Not done or incorrectly done was scored (0).

The total score for practice was calculated as follows:

- Satisfactory practice 80-100%.
- Unsatisfactory practice <80%.

Part (2): Observation Checklist for Implementation of Infection Control Protocol of Labor and Delivery Care Units

This part was used to assess hospital policy of infection control at labor and delivery care units before and after implementation of the educational program. It included questions related to: Presence of written and verbal infection control procedures; structure and human resources; committee responsibilities; infection control nurse responsibilities; antibiotic policy; sterilization and equipment care; and documentation.

Scoring system

- Done correctly and completely was scored as (2).
- Done correctly but incompletely was scored as (1).

-Not done or incorrectly done was scored as (0).

Total score

-Adequately implemented 80 -100%, inadequately implemented <80%.

Method

The study was implemented according to the following steps:

1- Official letter clarifying the purpose of the study was obtained from the Faculty of Nursing Tanta University, and submitted to the responsible authorities of the study settings.

2- Ethical and legal consideration Approval was obtained from the ethical committee of the Faculty of Nursing, Tanta University. All participants were informed about the purpose of the study. They were assured about anonymity and confidentiality of their answers, data will be used for only the purposed of this study, and that the study will not entail any harmful effect. Their rights to withdraw from the study at any time were guaranteed.

3- The study tools were developed by the researcher after reviewing recent related literature. Then, they were translated into the Arabic language and tested for content and construct validity by five experts in Maternal and Neonatal Health Department. The tools reliability were tested using Alpha Cronbach statistical test analysis that indicates high reliability of the study tools for knowledge 0.779 and for practice 0.818 . **Tool I and Tool II** were used to assess nurses' knowledge and performance before, immediately and one month after implementation of the educational program.

4- A pilot study was carried out on 10% (17 nurses) of the total sample to evaluate the clarity of the questions, the feasibility of the

study, the suitability of the settings, and the availability of the study populations. In addition it helped in determining the approximate time needed for the data collection. Then, the tools were finalized and prepared for the fieldwork. The pilot sample was included in the main study sample as there were no critical changes in the data collection tools.

5- The educational program was conducted through four phases (Assessment, planning, implementation and evaluation) as follows:

Phase I: Assessment phase

-This phase was done before giving the educational program sessions. The researcher met with the nurses at morning shifts during the period of data collection at the labor and delivery care units of the study settings. - The nurses were asked to participate after explanation of the aim of the study.

-They were interviewed individually by the researcher for 20-25 minutes to fulfill **Tool (I) part 1 and part 2**, (socio-demographic characteristics and nurses' knowledge regarding infection control at labor and delivery care units. the presence of the researcher for necessary clarification.

-Nurses' performance was assessed by the researcher individually for each nurse for every procedure using **Tool II part 1**.

Tool II part 2 was used by the researcher to assess hospital policy regarding infection control at labor and delivery care units before implementation of the educational program as the hospitals' policy is working for the rest of the year without change.

Phase II: Planning phase

a- Preparation for the educational program's sessions

-The total number of nurses was (170 nurses). They were distributed into 4 groups

according to the previously mentioned 4 hospital settings. Then, they were classified into (3 sub-groups at each hospital) to be 12 groups (total number of groups at the 4 hospitals).

- The content of the infection control program (theoretical and clinical components were developed by the researcher based on the pre assessment of nurses' needs and the relevant literatures (books, magazines) available locally and internationally. These included an educational booklet, infection control procedures such as hand hygiene, handling and disposing sharp instruments, donning and removing sterile gloves and personal protective equipment. The program included different methods of teaching as lecture, group discussion, posters, power point, demonstration and re-demonstration. The booklet was also distributed to every nurse to enhance nurses' knowledge regarding infection control at labor and delivery care units, and for encouragement and being a reference.

b- Setting the goals and objectives of the program

The goal of the program was to enhance the studied nurses' performance related to infection control.

The objectives of the program were to improve knowledge and performance of the studied nurses at labor and delivery care units regarding infection control for health care providers, for the environment and for the parturient women at labor and delivery care units.

Phase III: Implementation phase

The researcher implemented the program through 3 sessions for each group. 3 days per week. The duration of each session ranged from 20 to 45 minutes including periods of

discussion. The researcher implemented the program sessions as follow:

- **The first session:** The aim of this session was to enhance the nurses' knowledge about infection control at labor and delivery care units. It included definition of infection, definition of infection control, causes, types, sources, process, and modes of transmission, risk factors, and barriers to control infection, and complications to women and their newborns.

- **The second session:** The aim of this session was to provide the nurses with knowledge about standard infection control precautions for parturient women and their neonates, for health care providers and for the environment.

- **The third session:** The aim of this session was to demonstrate infection control procedures for nurses. It included demonstration and redemonstration of the following procedures: donning and removing sterile gloves, and personal protective equipment, hand hygiene, as well as handling and disposing sharp instruments.

Phase IV: Evaluation phase

The evaluation of the implemented program was done 3 times (before, immediately, and one month post implementation of the infection control program through:

- Individually assessment of the studied nurses' knowledge by the researcher using **Tool I part 2** before, immediately and one month after implementation of the educational program.

- Individually assessment of the studied nurses' performance by the researcher using **Tool II part 1** by the researcher three times before, immediately and one month after implementation of the educational program.

- Assessment of the hospital policy regarding infection control at labor and delivery care

units was done by the researcher using **Tool II part 2** one time before implementation of the educational program as the hospitals' policy is working for the rest of the year without any change.

-Data were collected from the previously mentioned settings by the researcher 3 days per week in the morning shifts from the beginning of January 2021 to the end of April 2021.

6- Statistical analysis

Statistical analysis was conducted, using the mean, standard Deviation, unpaired student t-test to compare between two groups in quantitative data, chi-square test was used to compare between groups in qualitative, ANOVA test was used for comparison among different times in the same group in quantitative data and linear correlation coefficient was used for detection of correlation between two quantitative variables in one group By (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). The level of significant was estimated as > 0.05 Non significant, $<0.05^*$ significant and $<0.001^*$ High significant

Results

Table (1): Shows socio-demographic characteristics of the studied nurses (N = 170 nurses). It reveals that (100%) were Muslim and females', (70.0%) were married, (90.6%) worked in hospitals that implement infection control programs and (61.8%) had taken infection control courses. Moreover, slightly more than one half of the studied nurses had Nursing Diploma (57.6%), slightly more than two fifths aged 40 years or more (42.4%) and with experience in nursing 20 years or more (42.4%).

Table (2): Shows knowledge of the studied nurses subscales (infection control, infection

control hospital acquired infection and standard infection control precautions at labor and delivery care units) pre, immediately and one month post program implementation (N = 170 nurses). It presents that relating to the studied nurses' knowledge about infection control, infection control hospital acquired infection and standard infection control precautions at labor and delivery care units, only (22.9% , 31.2% and 35.9% respectively) of the studied nurses had high knowledge level regarding infection control, infection control hospital acquired infection and standard infection control precautions at labor and delivery care units pre the educational program's implementation, compared to (71.8%, 72.4% and 70.0% respectively) immediately after (68.2% , 68.8% and 65.9% respectively) one month post the educational program's implementation with a highly statistical significant difference ($p < 0.001$).

Table (3): Demonstrates the studied nurses subscales of practices of infection control at labor and delivery care units pre, immediately and one month post program implementation (N = 170 nurses). It illustrate that there was a highly statistical significant difference (improvement) in nurses' practices immediately post program implementation from preprogram phase ($p < 0.001$) in all infection control subscales. In this regard, (33.5%, 37.1%, 38.8%, 42.4% and 37.1% respectively) of the studied nurses had satisfactory performance regarding (hand washing procedure, putting equipment (gloves, gown, over-head, over-shoes, mask and eye goggles), removing equipment (gloves, gown, over-head, over-shoes, mask and eye goggles), donning and removing sterile(surgical) gloves and safe sharps/waste disposal to control infection at labor and

delivery units) preprogram compared to (84.1%, 81.8%, 82.9%, 83.5% and 84.7% respectively) immediately post program implementation.

Figure (1): Illustrates percentage distribution of the studied nurses' total infection control knowledge(IC, IC of HAI and standard IC precautions) score pre, immediately and one-month post program implementation (N = 170 nurses). It shows that nearly one third of the studied nurses (31.2%) had high knowledge level regarding (infection control, infection control hospital acquired infection and standard infection control precautions at labor and delivery care units) pre the educational program's implementation, compared to (71.2%) immediately after and (67.6%) one month post the educational program's implementation on the other hand, (34.7%) had low knowledge pre the educational program implementation, compared to (8.80%) immediately after, and (15.9%) one month post the educational program's implementation.

Figure (2): The studied nurses total score level of practices of infection control at labor and delivery care units pre, immediately and one month post program implementation (N = 170 nurses). It reveals that total mean score of practice regarding infection control at labor and delivery care units was 71.4 pre-implementation of the program , increased to 168.71 immediately post implementation of the program, while increased to 173.64 one month post implementation of the program.

Table (4): Portrays correlation between nurses' total practice and total knowledge scores (N = 170 nurses). It presented that there is a highly statistical significant weak to moderate positive correlations among the scores of total nurses' infection control

practice and their knowledge in the three program phases (pre, immediately post and follow-up one month). The strongest correlation was between total practice and total knowledge immediately post program implementation where ($r=0.401$) and ($p<0.001$). On the other hand, the weakest

correlation was between total practice and total knowledge at one month post program implementation where ($r=0.278$) and ($p<0.001$).

Table (1): Distribution of the studied nurses at labor and delivery care units according to their socio-demographic characteristics (N = 170 nurse).

Items		N	%
Age (years)	<30	44	25.9
	30- <40	54	31.8
	40 or more	72	42.4
	Mean \pm SD	36.32 \pm 7.88	
Gender	Female	170	100.0
Qualification	Nursing Diploma	98	57.6
	Specialization diploma	25	14.7
	Institute of Technical health	26	15.3
	Bachelor of Nursing	19	11.2
	Master / PhD	2	1.2
Social status	Married	119	70.0
	Single	8	4.7
	Widow	27	15.9
	Divorced	16	9.4
Religion	Muslim	170	100.0
Number of years of experience in nursing	<10	51	30.0
	10- <20	47	27.6
	20 or more	72	42.4
	Mean \pm SD	16.22 \pm 7.76	
Years of experience in the maternity department	<10	56	32.9
	10- <20	59	34.7
	20 or more	55	32.4
	Mean \pm SD	14.76 \pm 7.85	

Table (1) continues: Distribution of the studied nurses at labor and delivery care units according to their socio-demographic characteristics (N = 170 nurse).

Items		N	%
Previous taken courses	Yes	65	38.2
	No	105	61.8
Previous working in hospitals implement infection control	Yes	154	90.6
	No	16	9.4

Table (2): Distribution of the studied nurses at labor and delivery care units according to their knowledge subscales pre, immediately and one month post program implementation (N= 170 nurse).

Levels of knowledge		High		Moderate		Low		Chi--square	
		N	%	N	%	N	%	X ²	P-value
Infection control	Pre	39	22.9	59	34.7	72	42.4		
	Immediate	122	71.8	40	23.5	8	4.7	97.63	<0.001*
	Post one month	116	68.2	34	20.0	20	11.8	5.78	0.056
Infection control of HAI	Pre	61	35.9	55	32.4	54	31.8		
	Immediate	119	70.0	33	19.4	18	10.6	42.18	<0.001*
	Post one month	112	65.9	28	16.5	30	17.6	3.62	0.163
Standard infection-control precaution	Pre	53	31.2	61	35.9	56	32.9		
	Immediate	123	72.4	30	17.6	17	10.0	59.23	<0.001*
	Post one month	117	68.8	25	14.7	28	16.5	3.29	0.193

Table (3): Distribution of the studied nurses at labor and delivery care units according to their total score level of practices of infection control standards pre, immediately and one month post program implementation (N = 170 nurses).

Items		Satisfactory		Unsatisfactory		Chi—square	
		N	%	N	%	X ²	P-value
Hand washing procedure.	Pre	57	33.5	113	66.5		
	Immediate	143	84.1	27	15.9	89.809	<0.001*
	Post one month	145	85.3	25	14.7	0.091	0.763
Putting equipment	Pre	63	37.1	107	62.9		
	Immediate	139	81.8	31	18.2	70.449	<0.001*
	Post one month	143	84.1	27	15.9	0.333	0.564
Removing equipment	Pre	66	38.8	104	61.2		
	Immediate	141	82.9	29	17.1	69.467	<0.001*
	Post one month	147	86.5	23	13.5	0.817	0.366
Donning and removing sterile gloves.	Pre	72	42.4	98	57.6		
	Immediate	142	83.5	28	16.5	61.786	<0.001*
	Post one month	148	87.1	22	12.9	0.844	0.358
Safe sharps/waste disposal	Pre	63	37.1	107	62.9		
	Immediately	144	84.7	26	15.3	81.026	<0.001*
	Post one month	152	89.4	18	10.6	1.671	0.196

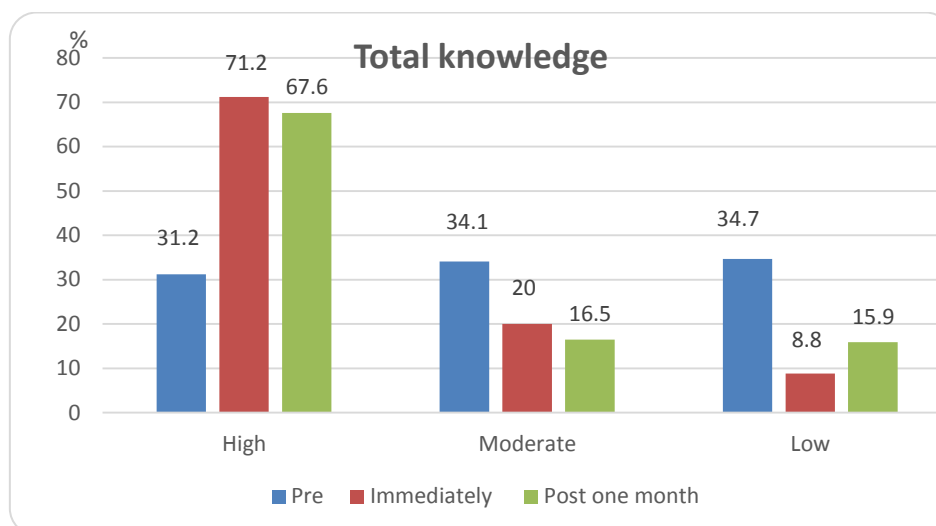


Figure (1): Percentage distribution of the studied nurses at labor and delivery care units according to their total infection control knowledge pre, immediately and one-month post program implementation (N = 170 nurse).

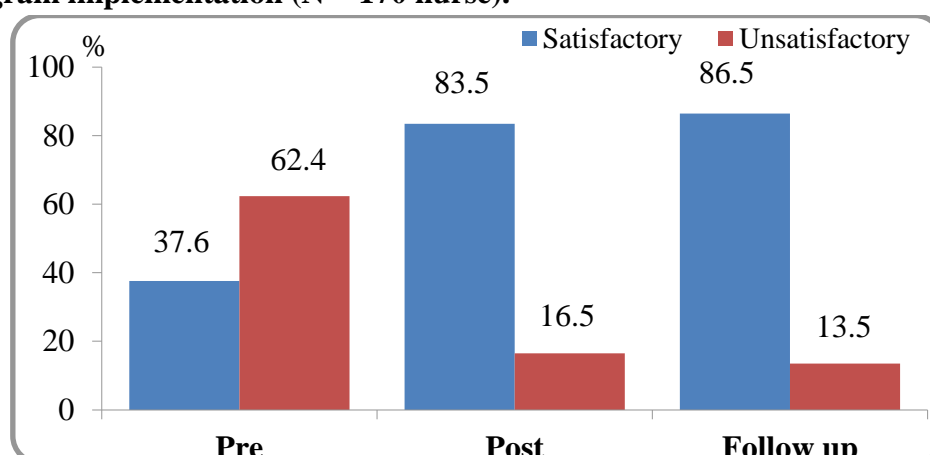


Figure (2): Distribution of the studied nurses at labor and delivery care units according to their total score level of practices of infection control standards pre, immediately and one month post program implementation (N = 170 nurses).

Table (4): Distribution of the studied nurses at labor and delivery care units according to correlation between their total practice and total knowledge scores (N = 170 nurses).

Total practice	Total Knowledge	
	R	P-value
Pre	0.298	<0.001*
Immediately	0.401	<0.001*
Post one month	0.278	<0.001*

Discussion

Infection during childbirth is one of the world's leading causes of maternal mortality. It is responsible for approximately one-tenth of the global maternal deaths burden, and the long-term disabilities such as chronic pelvic pain, fallopian tube blockage, and secondary infertility. Maternal infections during childbirth can threaten maternal and neonatal life [26,27]. Nurses have vital roles in infection control at labor and delivery care units to reduce the risk of death to related infection. They should have continued education and training programs to enhance their performance regarding infection control at labor and delivery care units. So, the aim of this study was evaluate the effect of educational program on nurses' performance regarding infection control at labor and delivery care units.

The results of this study indicated that regarding socio-demographic characteristics of the studied nurses, slightly more than two fifths were 40 years or more, all of them were Muslim and females', nearly three quarters were married and the majority worked in hospitals that implemented infection control measures. Moreover, nearly two fifth of the studied nurses had nursing diploma, and less than one half was over 40 and had at least 20 years of experience. These results are partially supported by **Abdelati, Ali, Yousif, and El-berdan (2018)** [28] who revealed that the majority of the nurses in their study were over 30 years old and slightly more than two fifth of them were 40 years or more and they had a diploma in nursing.

In the similar vein, **Ahmed (2018)** [29] revealed that the majority of Sudanese nurse midwives were 45 years of age or older and

had more than 10 years of experience. According to the results of a research done in Egypt by **EL-Shafey, El-Dakhakhny, and Mohammed (2019)** [30], the majority of participants had a nursing school certificate but had never attended any training on infection control procedures. Additionally, **Marey, Shabaan and Abo Gad (2020)** [31] found, three quarters of the study participants were married, and two-thirds of them never attended an infection control training session. In contrast, **Hassan, Malk, Abdelhamed and Genedy (2020)** [5] in Northern Upper Egypt who studied infection control knowledge and practice at labour unit were partially in line with this study. They found that the majority of staff nurses were females and that more than half of them were under the age of 25. From the researcher's point of view, this is because all Egyptian nurses in old generation were women because this profession was traditionally seen as solely belonging to women in Egypt and other nations in the region and the developing globe until recently. Thus, the participants in this study are representative sample of the nurses in our community.

With regards to knowledge of the studied nurses about infection control, were consistent with result of **Hassan, Malk, Abdelhamed and Genedy (2020)** [5] who concluded that as the main finding, a big slid (50.0%) of nurses had poor knowledge regarding infection control according to prior to the implementation of the program this percentage improved following program implementation as percent of nurses with good knowledge increased to (75%) immediately post program and (90.5%) two months following program implementation.

Moreover, the results of this study portrayed that regarding knowledge of the studied nurses about infection control of HAI, there was a statistically significant improvement of nurses' knowledge scores immediately post from pre-program implementation phase. Meanwhile, there was no statistical significant difference between nurses' knowledge score immediately post and one month follow-up phase of program implementation. Current study findings are congruent with **Alrubaiee, Baharom, Faisal, Shahar, Daud and Basaleem (2021)**^[33] who indicated that the results of the study provided evidence that participation in the intervention groups produced a significant improvement in the mean knowledge scores of NIs control measures over the three phases of the program implementation compared to the waitlist group.

This study also identified that knowledge of the studied nurses about standard infection- control precaution. it revealed that definition of standard precautions 73.5%, items of standard infection control precautions for nurses at labor and delivery care units 68.2%, standard infection control precautions for labor and delivery care units environment 77.6%, infection control procedures for nurses at labor and delivery care units 68.2% and procedures for controlling coronavirus infection at labor and delivery care units 72.9%. These findings are consistent with result of **Hassan, Malk, Abdelhamed and Genedy (2020)**^[5] who concluded that as the main finding, a big slid (50.0%) of nurses had poor knowledge regarding infection control according to prior to the implementation of the program this percentage improved following program implementation as percent of nurses with good knowledge increased to (75%)

immediately post program and (90.5%) two months following program implementation.

Regarding total infection control knowledge pre, immediately and one-month post program implementation, the findings of this study show that compared to the pre-program period, nurses' overall understanding of infection control improved significantly both immediately after and one month of the program. An explanation for this improvement might be attributed to the researcher's use of a variety of educational techniques, such as lectures and multimedia resources, along with discussions and the Arabic booklet provided to all nurses.

Concerning nurses' infection control practices (hand washing procedure, putting equipment (gloves, gown, over-head, over-shoes, mask and eye goggles), removing equipment (gloves, gown, over-head, over-shoes, mask and eye goggles), donning and removing sterile(surgical) gloves and safe sharps/waste disposal to control infection at labor and delivery units) current study findings indicate that there were highly statistically significant improvement in nurses' practice immediately post program implementation from preprogram phase in all infection control subscales, while, there was no statistically significant difference between nurses' practice immediately post and follow-up one month after program implementation.

These results are congruent with **Nasirudeen Koh, Lau, Li, Lim and Ow (2012)**^[33] who proved that 66.3% of the Singaporean students' practice were excellent with regards to hand washing procedure, putting equipment (gloves, gown, over-head, over-shoes, mask and eye goggles), removing equipment (gloves, gown, over-head, over-shoes, mask and eye goggles), donning and removing sterile(surgical) gloves and safe

sharps/waste disposal to control infection at labor and delivery units) .Our study hypothesis is supported by these data, which indicate that nurses' understanding and practice of infection control procedures improved as a consequence of the use of the educational program in this study.

The results of this study also verified that a great improvement is found regarding the studied nurses' total score level of practices of infection control standards pre, immediately and one month post program implementation.

These findings are in the same vein with Marey, Shabaan and Abo Gad (2020) ^[31] who concluded that pre-program majority (90.3%) of head nurses had mild level of performance of educational , consultation, research and support team in surveillance roles decreased to (3.2%) post program. Nurses range (15.4% - 22.9%) showed compliance level to infection control practices pre-program, improved to range (75.4% - 84.0%) post program with highly statistically significant differences ($p < 0.001$). Yousef, Elashir, Mahmoud and Maghraby (2019) ^[34] also documented that the in-service training program has a beneficial effect on improving the nurses' knowledge and skills. They also recommended that educational programs should be organized according to the needs of nurses with continuous evaluation.

The relationships between the scores of total nurses' infection control practices and their knowledge in the three stages of the program were also very statistically significant (pre, immediately post and follow-up one month). Many studies **Sarani, Balouchi, Masinaeinzhad and Ebrahimitabs (2016)** ^[35], **Luo, He, Zhou and Luo (2010)** ^[36] and **Marey, Shabaan and Abo Gad (2020)** ^[19] have identified a correlation between

knowledge and practice and have advocated that conventional precautions should be better understood and programs for HAI management should be put in place, as well as effective educational models should be used to teach healthcare workers.

Conclusion

Implementation of the educational program resulted in a significant improvement of nurses' performance regarding infection control at labor and delivery care units. This proves that the present study is greatly important for nurses, client and the overall nursing profession.

Recommendations

Based on the findings of the present study, it is recommended that:

I) Recommendations for nurses

Holding a weekly meeting for nurses with their supervisors to exchange ideas and discuss the difficulties related to IPC at labor and delivery care units. Conduction of in-service training programs for all nurses regarding IPC at labor and delivery care units, as well as for fresh graduated nurses prior to their employment to improve and update their knowledge and practices. Increase number of the nursing staff to overcome nursing shortage and improve nursing performance regarding IPC.

II) Recommendations for administration

Health care facilities should provide nurses with audio visual materials such as instructional booklets, videos, and textbooks, handouts, continuing educational programs and appropriate resources, as well as enhance them to attend scientific meetings, seminars, courses, workshops and conferences to improve their knowledge and practice regarding IPC. Additionally, written policies, protocols regarding IPC at labor and delivery care units, as well as facilities, equipment

and supplies should be made available for nurses. Furthermore, the hospital should implement regular evaluation for nurses' performance regarding IPC at labor and delivery care units to enhance their sense of duty and consciousness.

III) Recommendation for research

Conduction of more studies to identify and fulfill the gaps, factors and barriers related infection control at labor and delivery care units to improve nurses' knowledge and practice. It is also important to repeat the present study under different circumstances (large sampling, other settings, measurements and duration of management) in Egypt to ensure the generalization of the findings.

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