Nurses Practice Regarding Infection Control Measures during The Second Stage of Labor: A Multicenter Study

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ABSTRACT

Context: Infection prevention remains a significant public health challenge for healthcare systems, especially in maternity and delivery units. Good understanding and compliance of nurses with infection control measures during delivery are essential factors that improve maternal and neonatal outcomes and decrease morbidity and mortality.
Aim: This study aimed to assess nurses' practice regarding infection control measures during the second stage of labor in multiple centers.
Methods: Cross-sectional descriptive observational study was adopted in this study. The study population included all nurses working in labor rooms of four hospitals (100 nurses), namely Suez Canal University Hospital, Zagazig University Hospital, Ismailia General Hospital, And Zagazig General Hospital. Data collection tool encompassed a structured interviewing questionnaire to assess nurses' general characteristics, physical and organizational barriers that prevent nurses from complying with infection control measures, infection control practice checklist to assess nurses` compliance with infection control measures during the second stage of labor.
Results: The highest percentage of the studied nurses' age was between 19-<29 (56.6%, 63.8%). Near half were technical nurses (43.4%, 44.7%). The majority of the studied nurses had not had periodic checks. Also, most of them were vaccinated against viral hepatitis B (86.8%, 91.5%). There was a statistically significant difference between Ismalia and Zagazig hospitals in physical barriers. The highest mean percent for infection control practice was for perineal care 100%, using the invasive device during labor 92%, preparing birthing room and its equipment 75.9%. A satisfactory infection control practice was revealed among 88% of the studied nurses. The satisfactory practice of nurses was 100%, 92.1%, 86.9%, 44.1% in Zagazig General Hospital, Ismalia University Hospital, Zagazig University Hospital, Ismalia General Hospital, respectively.
Conclusion: The result of the study concluded that most nurses' practice regarding infection control in the delivery room was satisfactory. The study recommended upgrading and qualifying nurses in the labor room to improve their practical skills in Obstetric Nursing.

Keywords: Nurses' practice, infection control measures, second stage labor, multicenter study

1. Introduction

Maternal infection (sepsis) is a life-threatening condition that arises when the body's response to infection causes injury to its tissues and organs during pregnancy, childbirth, post-abortion, or postpartum. 23% of all maternal deaths were sepsis-related *(WHO, 2021)*. The ratio of intrahospital maternal infections was 70.4 women per 1000 live births, and 10.9 of 1000 livebirths presented with infection-related inducing severe maternal outcomes *(Bonet et al., 2020, Hensley et al., 2019)*. In lower-middle-income countries, neonatal deaths are due to infections acquired at home or in the hospital, and around 36% of the neonatal death occur due to infection *(Waters et al., 2011, Ayaz and Saleem, 2010)*

Maternal mortality is due to direct causes of mortality accounted for 77.7 %, while indirect causes contributed to 22.3 %. The most frequent cause of maternal mortality was puerperal sepsis (30.9%), followed by obstetric hemorrhage (21.6%), hypertensive disorders in pregnancy (14.4%), abortion complications (10.8%) *(Ngonzi et al., 2016)*. WHO's global burden of disease categorizes this as "Childbed fever," which is currently spelled out as "Puerperal sepsis." The WHO report estimated that 358,000 maternal deaths yearly due to childbirth problems, and out of these, up to 15% are associated with puerperal sepsis *(Edwards and Hanke, 2013, Benita, 2014, Wilcox et al., 2016)*.

Infections may be acquired during labor or the postpartum period. Conducting deliveries in unhygienic places or not properly disinfected labor rooms increases the risk of spreading infections. Infection control policies and procedures are used to reduce the risk of infection transmission, especially in hospitals and health care settings *(Bouallègue et al., 2013, Ahmed, 2018)*. Moreover, mothers might be exposed to infection due to multiple examinations by health care providers during the process of labor *(Waters et al., 2011, Ayaz and Saleem, 2010)*.

Infection prevention and control (IPC) is a scientific approach and practical solution designed to prevent harm caused by infection to patients and health workers. It is one of the most important fields of concern in the labor and delivery room as the mothers and newborn babies have a

high chance for infection from all surroundings persons and environment immediately after labor. Infection control measures include relatively inexpensive strategies through the adherence to recommended infection prevention practices, especially hand hygiene, personal protective equipment when handling blood, body substances, excretions, and secretions. Also, the correct application of basic precautions during invasive procedures, appropriate handling of patient care equipment, soiled linen, preventing needle stick/sharp injuries, environmental cleaning, spills-management, and appropriate handling of waste. These procedures require staff accountability and behavioral change and improve staff education *(Bouallègue et al., 2013)*.

Nurses were known as the backbone of the health care team; therefore, the Center for Disease Control and Prevention (CDC) did set a preventive guideline to help health care professionals, especially nurses to protect themselves and their patients from the transmission of microorganisms, especially it was reported that nurses have high rates of exposure to microorganisms via several modes such as needle sticks, hand contamination with blood and air transmitted microorganisms *(Abdulraheem et al. 2012)*.

So, nurses must comply with infection control measures, as compliance is defined as always adherence to the settings' policies, protocols, and guidelines. Nurses may acquire an infection during the provision of nursing care because of their lack of compliance with the settings' infection preventive measures. The chances of infection increase if the precautions are not taken appropriately, especially by nursing staff, who are responsible for caring for mothers and neonates in the hospital *(Ali and Ali, 2017)*.

Many studies showed that using women for government health facilities for childbirth may not guarantee safe delivery. Also, infection control procedures and practices during labor and delivery in health facilities need improved information systems, protocols, procedures, and training *(Tabatabaei et al., 2016, Mehta et al., 2011)*.

Many factors are predisposing to the development of infection in women during the second stage of labor include home birth in unhygienic conditions, prolonged labor with or without rupture of membranes, multiple vaginal examinations in labor, obstetrical maneuvers. In addition, it has been shown that pre-existing medical problems, febrile illness, or taking antibiotics two weeks before presentation, operative vaginal delivery, and cesarean section may be associated with severe puerperal infections. However, little is known about the hospital-related factors predisposing pregnant women to puerperal infection *(Tabatabaei et al., 2016)*.

The second stage of labor commences with complete cervical dilation and ends with the delivery of the neonate. This stage was also defined as the pelvic division phase by Friedman. After complete cervical dilation, the fetus descends into the vaginal canal with or without maternal pushing efforts. The fetus passes through the birth canal via seven movements known as cardinal movements. These include engagement, descent, flexion, internal rotation, extension, external rotation, and expulsion *(Mirza et al., 2016)*.

The unhygienic delivery practices by health personnel and shortage of suitable clean implements and materials contribute to the infection problem after childbirth. The burden of diseases resulting from infection has led to a revival of general interest in infection control. The worldwide incidence of infection during labor has become a growing issue day by day *(Edwards and Hanke, 2013, Benita, 2014, Wilcox et al., 2016)*.

2. Significance of the study

Nowadays, maternal sepsis has become uncommon in developed countries following antibiotic therapy, improved social infrastructure, and systematic use of infection control measures in healthcare, despite Egypt being considered one of the only 23 countries that achieved a 75% decrease in maternal mortality rate (MMR) in 2015 and are considered a developing country. The lack of surveillance systems in developing countries like Egypt underestimates the global burden of Healthcare-associated infections (HAIs). Enhancing infection prevention and control programs should be an infection control priority in Egypt *(Hogan et al., 2010, Talaat et al., 2016)*. *Shaalan (2018)* added that nurses have a poor level of knowledge regarding standard precautions. There is a relation between age, education, work experience, and knowledge of standard precautions. So, this study was conducted to assess nurses' practice regarding infection control measures during the second stage of labor in multicenter.

3. Aim of the study

To assess nurses' practice regarding infection control measures during the second stage of labor in multiple centers.

The objectives of this multicenter study are
- Assess the practices of nurses regarding infection control measures during the second stage of labor.
- Assess the barriers that hinder nurses' practice regarding infection control measures during the second stage of labor.
- Compare the practices of nurses regarding infection control measures during the second stage of labor in the study centers.

4. Subjects & Methods

4.1. Research Design

A cross-sectional descriptive observational study was adopted in this study. It is a type of observational study that analyzes data from a population, or a representative subset, at a specific point in time *(Setia, 2016)*.

4.2. Study setting

The study was conducted in labor rooms at Suez Canal University Hospital, Zagazig University Hospital, Ismailia General Hospital, and Zagazig General Hospital.

The settings mentioned above were chosen because of their sizes and capacity to receive many patients. They are

the largest general hospitals that provide a wide range of free maternity services. Also, it is the largest government center for vaginal delivery and having the highest number of nurses working on it.

4.3. Subjects

During data collection, all nurses in labor rooms in previously mentioned hospitals were recruited in this study, subtracted 10 of them as a pilot sample; their number was =100.

4.4. Tools of data collection

Data were collected using two tools:

4.4.1. A Structured Interviewing Questionnaire

It was developed by *Habeeb-Allah (2011)* and modified by the researcher. It involved four parts:
The first part aimed to assess nurses' general characteristics such as age, education, marital status, residence, vaccination status against HBV, and periodic checkups. In addition to their experience and attending a training program. It included eight closed-end questions.

4.4.2. Infection Control Audit

This tool aimed to assess barriers preventing nurses from complying with infection control measures correctly during the second stage of labor. It included assessing two main groups of barriers. The first barriers include physical barriers such as the availability of infection control measures (11 items) as flooring type, washbasin, liquid soap, and ceramic wall. Besides the availability of infection control equipment such as antiseptics, personal protective equipment, clean towels, and safety boxes (12 items). These barriers are coded as yes (for the absence of the barrier, presence of the facilities), no (for the barrier presence, absence of the facilities), Dys. (when the item is not available due to a malfunction).

The second group of barriers is the organizational barriers, such as the presence of an infection control team and infection control policy inside the delivery room. It included 17 close-end questions and two open-end questions (19 questions). These barriers are coded by the researcher as NA (for the item is not applicable), yes (for the absence of the barrier, presence of the items), no (for the barrier presence, or the item is not present), NK (not known by the nurse).

4.4.3. Infection Control Practice Checklist

The tool was adopted from Infection Control Assessment Tool *(Strengthening Pharmaceutical Systems, 2009).*and modified by the researcher based on related literature *(2009)*. It was used to assess nurses` compliance with infection control measures during the second stage of labor.

It included the following areas: Preparing birthing room and its equipment (10 items), hand washing (5 items), scrub for vaginal deliveries (6 items), wearing personal protective equipment during delivery (9 items), using invasive devices in labor and delivery (8items) and perineal care (6 items). They were evaluated as a two-point scale of done and not done.

Scoring system

Each nurse was given two scores for the done step and one for that was not done. A total score of 60% and more was considered satisfactory practice, while a score below 60% was considered unsatisfactory *(Ezz-edeen, 2011)*.

4.5. Procedures

The operational design included the preparatory phase, content validity, pilot study, and fieldwork.

Preparatory phase: The investigator prepared the data collection tools based on a review of relevant literature.

Tool validity: A jury of five experts from both Zagazig and Ismailia universities' Nursing Faculty have reviewed the tools for clarity, relevance, comprehensiveness, understanding, and ease of implementation. According to their suggestions, the modifications were applied. Cronbach's α alpha test measured tool reliability. The tools' reliability was presented in table 1.

Table (1): Reliability of study tools based on standardized items.

Tools	Sample	No. of items	F	P-value	alpha Cronbach
infection control audit	100	34	7.26	<0.001	0.802
Infection control practice checklist	100	41	1.780	0.002	0.965

A pilot study was conducted on 10% of the study sample to examine the clarity and practicability of the study tools and the feasibility of the research process. It was carried out for one month and involved ten nurses. Nurses have been filled the interviewing questionnaire; then, the infection control audit and practice checklist has been filled out by the investigator during the second stage of labor within half to one hour. Data obtained from the pilot study were analyzed. Based on its results, modifications of the study tools were done. The sample used for the pilot study was excluded from the study sample.

Fieldwork: Data were collected within six months, started in June 2018 and ended in November 2018. The investigator attended morning, afternoon, and night shifts to meet all nurses and evaluate them during the second stage of labor. Data was collected four days per week from nurses' work at the delivery room at Suez Canal university hospital and Zagazig university hospital on Saturday and Wednesday interchangeably, Ismailia general hospital on Sunday, and Zagazig general hospital on Friday.

The investigator selected all nurses in the delivery room in the mentioned hospitals, introduces herself, and explains the purpose of the study for each nurse. The investigator interviewed each nurse individually for five minutes to explain the aim of the study to obtain their cooperation.

The interviewing questionnaire was completed within ten to fifteen minutes by the nurse. The researcher

evaluated each nurse twice or more due to the low number of nurses compared to cases, especially during afternoon and night shifts.

Before the conduction of this study, a written letter was issued from the dean of the faculty of nursing, Suez Canal University, directed to every director of each mentioned hospital to obtain permission to conduct this study. The aim of this study was explained to the directors, physicians, and staff nurses, stressing the confidentiality of the information collected.

All ethical considerations were considered for privacy and confidentiality; verbal approval was obtained from nurses who participated in the study before conducting the study, ensuring nurses that these data will be used for the research purpose only. She has the opportunity to withdraw at any time.

4.6. Data analysis

Data was collected, presented in tabular form. Percentages were calculated for qualitative data, mean and standard deviations were calculated for quantitative data. The raw data were coded and entered SPSS system files (SPSS package version 20). Analysis and interpretation of data were conducted. The following statistical measures were used: Descriptive statistics, including frequency, distribution, mean, and standard deviation, described different characteristics. The following statistical techniques were used:

- An independent t-test is used to determine if there is a significant difference between the means of the two groups.
- The Chi-square test (X2 test) is used to determine whether there is a statistically significant difference between the expected frequencies and the observed frequencies in one or more categories.
- r test (Correlation Coefficient) reveals the strength and direction of the linear relationship between two variables.
- Proportion probability of error (P-value) was considered at p ≤0.05.

5. Results

Table 2 shows a non-significant difference in age between Zagazig and Ismailia groups regarding all sociodemographic parameters except for mean age. Concerning age, 56.6% versus 63.8% were in the age group between 19-<29, 32.1% versus 36.2% were in the age group between 29-<39 and 11.3% versus 0% in the age group between 39-<49. Near half of the nurses had a technical level of education in both groups, 43.4% and 44.7%. Most of them are married, 86.8% and 68.1%, 56.6% and 31.9%, are rural residents, and most of them are vaccinated against HBV 86.8% and 91.5%, but the majority do not conduct periodic checkups 94.3% and 89.4 respectively.

Figure 1 shows that half of the nurses had >5 years of experience in the delivery room in the two groups with 57.4% and 49.1%, respectively.

Figure 2 shows that nearly half of the studied nurses attended monthly courses in infection control 42.6%, 45.3% in Ismailia and Zagazig hospitals, respectively.

Table 3 shows the total mean score of nurses' practices regarding infection control in delivery rooms was 29.86±4.47, with a mean percentage of 67.88%. The highest mean percentage for nurses practice was perineal care 100%, followed by using invasive devices during labor 92%, then preparing birthing room and its equipment 75.9%, hand washing 65.45%. Low mean percentages were revealed for wearing personal protective equipment 39.33%, followed by scrub for vaginal delivery 35%.

Table 4 demonstrates non-statistically significant differences between Ismailia and Zagazig hospitals regarding all infection control practices in the delivery room and the total score.

Table 5 shows a non-statistically significant difference between Ismailia and Zagazig university hospital's total infection control practice scores. The table also shows statistically significant differences between Ismailia and Zagazig university hospital regarding the preparing birthing room and its equipment and using invasive devices during labor with p-value 0.04 and 0.016, respectively.

Table 6 shows a non-statistically significant difference between Ismailia and Zagazig general hospital total infection control practice scores. The table also shows a statistically significant difference between Ismailia and Zagazig general hospitals regarding handwashing with a p-value of 0.002.

Figure 3 illustrates satisfactory infection control practices in 88% of the studied nurses, while unsatisfactory nurses' practice represented 12%.

Table 7 reveals that satisfactory practice of nurses was 100%, 92.1%, 86.9%, 44.1% in Zagazig General Hospital, Ismailia University Hospital, Zagazig University Hospital, Ismailia General Hospital, respectively.

Table 8 demonstrates the comparison of physical barriers in the studied hospitals. The table demonstrates that the floors of all delivery rooms were ceramic, the water source was available in all hospitals. All hospitals had generators and working autoclaves. Availability of liquid soap, Clorox, alcohol, betadine, masks, apron, safety boxes, and containers for different wastes in a percentage of 100% in all hospitals. The bathroom was outside the room in all hospitals. The walls of the delivery room were ceramic except the wall of Ismailia university hospital.

There is a hand wash basin with water inside the Zagazig and Ismailia university hospitals and outside the room in general hospitals. The air conditioner was not available at Ismailia general hospitals. Water resource was available in all studied hospitals. An adequate number of sterile gloves were not available at the percentage of 26.6% in Zagazig general hospitals. The overhead was available in Zagazig university and Ismailia general hospitals and not available with 5.3%, 13.3% at Ismailia university and Zagazig general hospitals, respectively.

Eye googles were not available at 100%, 97.3%, 80%, and 73.7% in Ismalia general, university, Zagazig general, and university hospitals. Overshoes are available only at

Zagazig University and general hospitals at the percentage of 92.1%and 100%. Clean towels were available in a percentage of 73.7% and 86.6% at Zagazig University and Zagazig general hospitals, respectively, and not found at Ismailia university and Ismailia general hospitals. There was a statistically significant difference between Ismailia and Zagazig hospitals in physical barriers at p 0.000.

Table 9 shows the comparison of organizational barriers in the studied hospitals. The nurses reported the availability of an infection control team inside the delivery rooms 55.6%, 92.1, 93.3%, and 100% in Ismailia general, University and Zagazig general, and university hospitals. Policies were reported by 88.9%, 86.8%, 100%, and 97.4 of the nurses in Ismailia university, general, and Zagazig general and university hospitals. A guidebook is available for all health team members 100%, 81.6%, 100%, 94.7% in Ismailia general, University and Zagazig general, and university hospitals.

Get rid of the safety box when three-quarters are filled was reported by 88.9%,94.7&, 100%, and 100% of the nurses in Ismailia general, University and Zagazig general, and university hospitals. Periodic cleanliness in the delivery room from the ceiling to the floor was reported by 100%, 94.7%, 100%, and 100% Ismailia general, University and

Zagazig general, and university hospitals. Use antiseptics in cleaning was reported by 100% of nurses in all hospitals.

There was no fixed system for recording hospital-acquired infections for the employees of the delivery rooms. The labor room closed by 77.8%, 68.4 to prevent transmission of any infection in Ismailia general and university hospitals and by 13.3%, 2.6% in Zagazig general and university hospitals. Comparing the studied hospitals' organizational barriers shows a statistically significant difference between Ismailia and Zagazig hospitals. Moreover, there was a statistically significant difference between Ismailia and Zagazig general hospitals in organizational barriers (p=0.026). In contrast, there is a non-significant difference between Ismailia hospital and Zagazig university hospital regarding organizational barriers (p=0.47).

Table 10 represents the percentage and distribution of the agency responsibilities for the supervision and the other barriers regarding infection control in delivery rooms (n=100). The table shows that 66% of the studied sample reported that the agency responsible for the supervision was the infection control team. Also, it reveals that other barriers regarding infection control include decreased number of nurses and lack of supplies with 28% and 24%, respectively.

Table (2): Frequency and percentage distribution of the studied nurse's demographic characteristics (n=100).

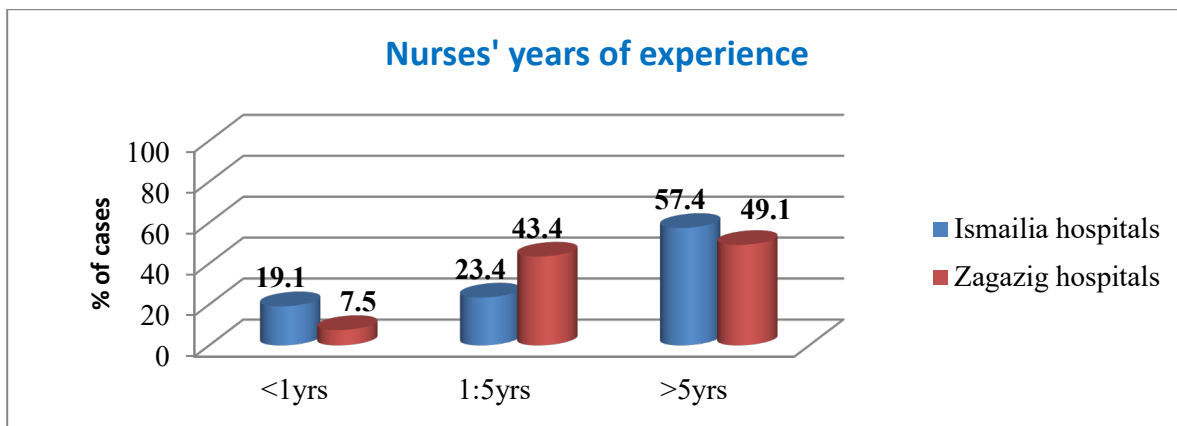| Demographic characteristics	Zagazig group (n=53)		Ismailia group (n=47)		Test	P-value
	N	%	N	%		
Age (Years)						
19-<29 years	30	56.6	30	63.8		
29-<39 years	17	32.1	17	36.2	X^2=0.118	0.943
39-<49 years	6	11.3	0	0		
Mean±SD	30.18±6.07		27.57±6.36		t=2.039	0.039*
Range	23-48		19-39			
Education						
Bachelor degree	22	41.5	5	10.6		
Technical Institute	23	43.4	21	44.7	X^2=5.106	2.077
Secondary school diploma	8	15.1	21	44.7		
Marital status						
Single	4	7.5	15	31.9		
Married	46	86.8	32	68.1	X^2=1.645	0.439
Divorced	2	3.8	0	0		
Widowed	1	1.9	0	0		
Residence						
Urban	23	43.4	32	68.1	X^2=4.127	0.248
Rural	30	56.6	15	31.9		
Vaccinations (HBV)						
Yes	46	86.8	43	91.5	X^2=0.900	0.925
No	7	13.2	4	8.5		
Periodic checkup						
Yes	3	5.7	5	10.6	X^2=0.222	0.637
No	50	94.3	42	89.4		

Figure (1): Percentage distribution of studied nurses' years of experience in Ismailia and Zagazig hospitals (n=100).
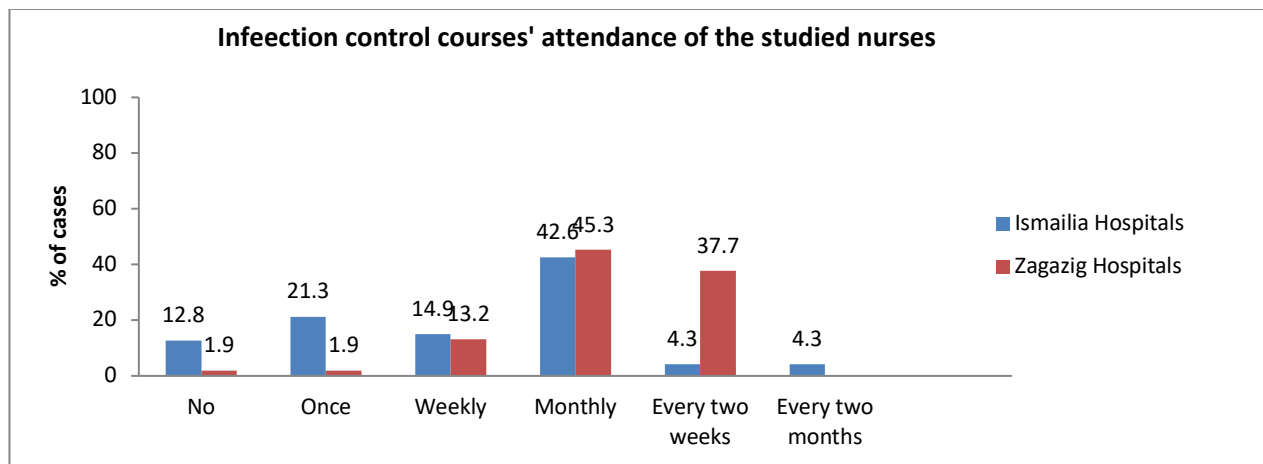

Figure (2): Percentage distribution of infection control courses' attendance of the studied nurses in Ismailia and Zagazig hospitals (n=100).

Table (3): Mean score of the infection control practice among the studied nurses in the delivery room (n=100).

Infection control practices	Total	Mean± SD	Mean percentage (%)
Preparing birthing room and its equipment	10	7.59±0.94	75.9
Hand washing	5	3.27±1.09	65.454
Scrub for vaginal deliveries	6	2.10±2.12	35
Wearing personal protective equipment during delivery	9	3.54±1.39	39.33
Using invasive devices during labor	8	7.36±0.64	92
Perineal care	6	6.00±0.00	100
Total score	44	29.86±4.47	67.883

Table (4): Comparison of nurse's infection control practices of nurses in delivery rooms in Ismalia and Zagazig hospitals (n=100).

Infection control practices	Total	Ismailia hospitals (47) Mean± SD	Zagazig hospitals (53) Mean± SD	t-test	P-value
Preparing birthing room and its equipment	10	7.72±0.92	7.47±0.95	1.336	0.185
Hand washing	5	3.08±1.10	3.44±1.07	1.634	0.106
Scrub for vaginal deliveries	6	1.91±2.17	2.26±2.08	0.819	0.415
Wearing personal protective equipment during delivery	9	3.59±1.31	3.49±1.47	0.374	0.70
Using invasive devices during labor	8	7.48±0.62	7.24±0.64	1.917	0.058
Perineal care	6	6.00±0.00	6.00±0.00	-	-
Total score	44	29.80±4.77	29.92±4.23	0.869	0.900

Table (5): Comparison of nurses' infection control practices of nurses in delivery rooms in university hospitals of Ismailia and Zagazig hospitals (n=76).

Infection control practices	Ismailia university hospital (38) Mean± SD	Zagazig university hospital (38) Mean± SD	t-test	P-value
Preparing birthing room and its equipment	7.78±0.84	7.36±0.91	2.08	0.04
Hand washing	3.23±1.12	3.67±1.08	1.67	0.09
Scrub for Vaginal Deliveries	2.07±2.23	2.60±2.13	1.04	0.29
Wearing personal protective equipment during delivery	3.71±1.27	3.73±1.51	0.08	0.93
Using invasive Devices during labor	7.55±0.60	7.18±0.69	2.47	0.01
Perineal care	6.00±0.00	6.00±0.00	-	-
Total score	30.36±4.73	30.59±4.30	0.17	0.85

Table (6): Comparison of nurses' infection control practices in delivery rooms in general hospitals of Ismailia and Zagazig hospitals (n=24).

Infection control practices	Ismalia general hospital (9) Mean± SD	Zagazig general hospital (15) Mean± SD	t-test	P-value
Preparing birthing room and its equipment	7.44±1.23	7.73±1.03	0.619	0.54
Hand washing	2.44±0.72	2.86±0.83	1.25	0.002
Scrub for Vaginal Deliveries	1.22±1.85	1.40±1.72	0.238	0.81
Wearing personal protective equipment during delivery	3.11±1.45	2.86±1.18	0.449	0.65
Using invasive Devices during labor	7.22±0.66	7.40±0.50	0.739	0.66
Perineal care	6.00±0.00	6.00±0.00	-	-
Total score	27.44±4.41	28.26±3.69	0.491	0.62
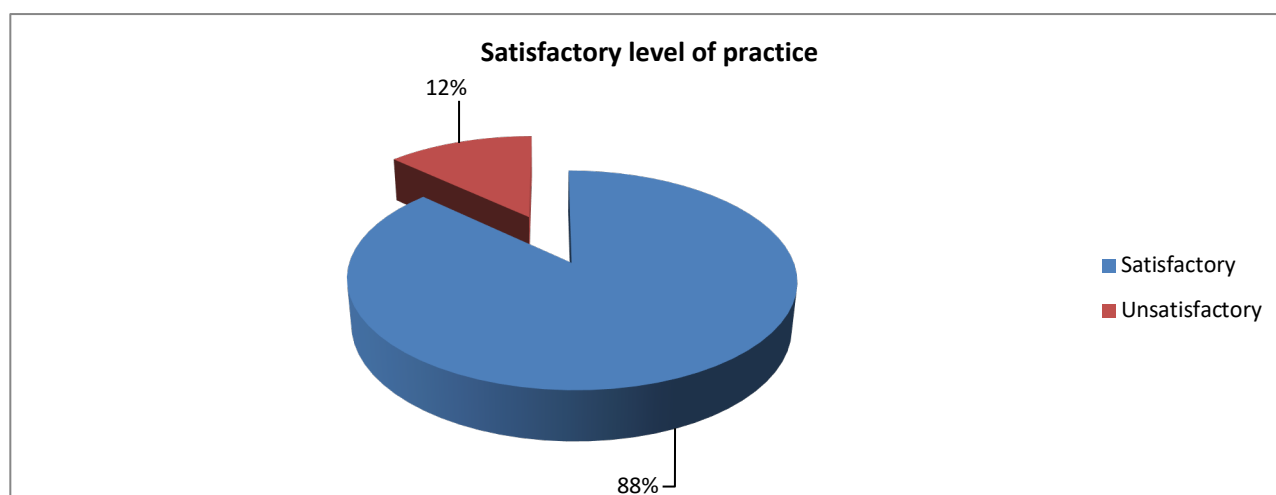
Figure (3): Percentage distribution of total level of nurses' infection control practice in the delivery room (n=100).

Table (7): Percentage distribution of satisfactory infection control practices in the delivery room in the studied hospitals (n=100).

Studied hospitals	Practice level (n=100)			
	Satisfactory		Un satisfactory	
	N	%	N	%
Ismalia University Hospital	35	92.1	3	7.9
Zagazig University Hospital	33	86.9	5	13.1
Ismalia General Hospital	4	44.1	5	55.9
Zagazig General Hospital	15	100	0	0

Table (8): Frequency and percentage distributions of physical barriers in Ismailia (University/General) and Zagazig hospitals (University/General) (n=100).

Physical barriers	Ismalia hospitals (n=47)						Zagazig hospitals (n=53)					
	University (38)			General (9)			University (38)			General (15)		
	Dys.	Yes	No	Dys.	Yes	No	Dys.	Yes	No	Dys.	Yes	No
	N	N	N	N	N	N	N	N	N	N	N	N
	%	%	%	%	%	%	%	%	%	%	%	%
Ceramic floor	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
There is a hand wash basin with water inside the room	0	38	0	0	0	9	0	38	0	0	0	15
	0	100	0	0	0	100	0	100	0	0	0	100
The presence of liquid soap or alternative use in a correct way	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Ceramic wall	0	0	38	0	9	0	0	38	0	0	15	0
	0	0	100	0	100	0	0	100	0	0	100	0
The lighting is excellent	2	36	0	0	9	0	1	37	0	3	12	0
	5.3	94.7	0	0	100	0	2.7	97.3	0	20	80	0
Air conditioner	0	38	0	0	0	9	2	36	0	4	11	0
	0	100	0	0	0	100	5.3	94.7	0	26.6	73.3	0
A bathroom is in the room	0	0	38	0	0	9	0	0	38	0	0	15
	0	0	100	0	0	100	0	0	100	0	0	100
Provide water source	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Generator	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Electric oven	0	0	38	0	0	9	0	38	0	0	15	0
	0	0	100	0	0	100	0	100	0	0	100	0
Working Autoclave	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Clorox	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Alcohol	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Betadine	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Provide an adequate number of sterile gloves of all kinds	0	38	0	0	9	0	0	38	0	4	11	0
	0	100	0	0	100	0	0	100	0	26.6	73.3	0
Provides overhead	2	36	0	0	9	0	0	38	0	2	13	0
	5.3	94.7	0	0	100	0	0	100	0	13.3	86.6	0
Availability of Masks	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Availability of Eye Google	37	1	0	9	0	0	28	10	0	12	3	0
	97.3	2.7	0	100	0	0	73.7	26.3	0	80	20	0
Availability of Apron	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Availability of overshoes	0	0	38	0	0	9	3	35	0	0	15	0
	0	0	100	0	0	100	7.9	92.1	0	0	100	0
Availability of clean towel	0	0	38	0	0	9	10	28	0	2	13	0
	0	0	100	0	0	100	26.3	73.7		13.3	86.6	0
Availability of safety box	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Availability of containers for different wastes	0	38	0	0	9	0	0	38	0	0	15	0
	0	100	0	0	100	0	0	100	0	0	100	0
Total Percentage	4.7	73.6	21.7	4.3	69.6	26.1	5	90.7	4.3	7.8	83.5	8.7
Chi-square Monte Carlo Sig. (2-sided)	175.32 P-value (.000)											

Table (9): Comparison of organizational barriers in Ismailia (general/university) and Zagazign (general/university) hospitals.

Organizational barriers	Ismailia general hospital (n=9)				Ismailia university hospital (38)				Zagazig general hospital (n=15)				Zagazig university hospital (38)				T1/p1	T2/p2
	NA N %	Yes N %	No N %	NK N %	NA N %	Yes N %	No N %	NK N %	NA N %	Yes N %	No N %	NK N %	NA N %	Yes N %	No N %	NK N %		
There is an infection control team inside the delivery rooms	0 / 0	5 / 55.6	3 / 33.3	1 / 11.1	0 / 0	35 / 92.1	2 / 5.3	1 / 2.6	0 / 0	14 / 93.3	1 / 6.7	0 / 0	0 / 0	38 / 100	0 / 0	0 / 0	2.61 / 0.026	0.71 / 0.47
There are policies to implement the infection control system in the delivery rooms	0 / 0	8 / 88.9	1 / 11.1	0 / 0	0 / 0	33 / 86.8	1 / 2.6	4 / 10.5	0 / 0	15 / 100	0 / 0	0 / 0	0 / 0	37 / 97.4	1 / 2.6	0 / 0		
There are possibilities for assistance from the rest of the health team	0 / 0	9 / 100	0 / 0	0 / 0	0 / 0	37 / 97.4	1 / 2.6	0 / 0	0 / 0	15 / 100	0 / 0	0 / 0	0 / 0	37 / 97.4	0 / 0	1 / 2.6		
All members of the health team committed to infection control methods	0 / 0	5 / 55.6	3 / 33.3	1 / 11.1	0 / 0	28 / 73.7	9 / 23.7	1 / 2.6	0 / 0	12 / 80	3 / 20	0 / 0	0 / 0	37 / 97.4	0 / 0	1 / 2.6		
There is a guidebook on infection control policies and methods inside the unit available for all members of the health team	0 / 0	9 / 100	0 / 0	0 / 0	0 / 0	31 / 81.6	2 / 5.3	5 / 13.2	0 / 0	15 / 100	0 / 0	0 / 0	1 / 2.6	36 / 94.7	0 / 0	1 / 2.6		
Periodic monitoring for applying infection control methods inside the delivery room	0 / 0	9 / 100	0 / 0	0 / 0	0 / 0	34 / 89.5	2 / 5.3	2 / 5.3	0 / 0	14 / 93.3	1 / 6.7	0 / 0	1 / 2.6	35 / 92.1	1 / 2.6	1 / 2.6		
Microbial cultivars periodically placed inside the delivery room	8 / 88.9	0 / 0	1 / 11.1	0 / 0	25 / 65.8	3 / 7.9	6 / 15.8	4 / 10.5	0 / 0	8 / 53.3	7 / 46.7	0 / 0	29 / 76.3	0 / 0	8 / 21.1	1 / 2.6		
Getting rid of the safety box when three-quarters are filled	0 / 0	8 / 88.9	0 / 0	1 / 11.1	0 / 0	36 / 94.7	1 / 2.6	1 / 2.6	0 / 0	15 / 100	0 / 0	0 / 0	0 / 0	38 / 100	0 / 0	0 / 0		
Periodic cleanliness of the delivery room from the ceiling to the floor	0 / 0	9 / 100	0 / 0	0 / 0	0 / 0	36 / 94.7	2 / 5.3	0 / 0	0 / 0	15 / 100	0 / 0	0 / 0	0 / 0	38 / 100	0 / 0	0 / 0		
Use antiseptics in cleaning	0 / 0	9 / 100	0 / 0	0 / 0	0 / 0	38 / 100	0 / 0	0 / 0	0 / 0	15 / 100	0 / 0	0 / 0	0 / 0	38 / 100	0 / 0	0 / 0		
There is an infection control committee in the hospital	0 / 0	9 / 100	0 / 0	0 / 0	0 / 0	38 / 100	0 / 0	0 / 0	0 / 0	15 / 100	0 / 0	0 / 0	0 / 0	38 / 100	0 / 0	0 / 0		
There is an infection control coordinator in the hospital	8 / 88.9	0 / 0	1 / 11.1	0 / 0	1 / 2.6	33 / 86.8	0 / 0	4 / 10.5	0 / 0	15 / 100	0 / 0	0 / 0	0 / 0	38 / 100	0 / 0	0 / 0		
There is a system for investigating cases of acquired infections of natural births	8 / 88.9	0 / 0	0 / 0	1 / 11.1	21 / 55.3	4 / 10.5	6 / 15.8	7 / 18.4	0 / 0	8 / 53.3	3 / 20	4 / 26.7	2 / 5.3	0 / 0	30 / 78.9	6 / 15.8		
There is a system for recording hospital-acquired infections for the employees of the delivery rooms	8 / 88.9	0 / 0	0 / 0	1 / 11.1	21 / 55.3	7 / 18.4	4 / 10.5	6 / 15.8	0 / 0	4 / 26.7	6 / 40	5 / 33.3	2 / 5.3	0 / 0	31 / 81.6	5 / 13.2		
The delivery room has been closed to prevent transmission of infection	0 / 0	7 / 77.8	2 / 22.2	0 / 0	3 / 7.9	26 / 68.4	2 / 5.3	7 / 18.4	0 / 0	2 / 13.3	12 / 80	1 / 6.7	6 / 15.8	1 / 2.6	28 / 73.7	3 / 7.9		
There is a periodic system for the evaluation and maintenance of sterilization devices by the competent engineer	8 / 88.9	0 / 0	1 / 11.1	0 / 0	1 / 2.6	28 / 73.7	2 / 5.3	7 / 18.4	0 / 0	12 / 80	0 / 0	3 / 20	13 / 34.2	25 / 65.8	0 / 0	0 / 0		
There is supervision on infection control measures	0 / 0	9 / 100	0 / 0	0 / 0	2 / 5.3	36 / 94.7	0 / 0	0 / 0	0 / 0	15 / 100	0 / 0	0 / 0	0 / 0	38 / 100	0 / 0	0 / 0		
Total percent	26.1	49.8	7.8	16.3	11.5	75	5.9	7.6	0	82	12.9	5.1	8.4	73.4	15.3	2.9		
T3/p3				T Test: 2.03					P value: 0.046									

T1/p1 is the difference between Ismailia general hospital and Zagazig general hospital. T2/p2 is the difference between Ismailia university hospital and Zagazig university hospital. T3/p3 is the difference between Ismailia hospitals and Zagazig hospitals.

Table (10): Frequency and percentage distribution of agency responsibilities toward infection control practices (n=100).

Agency responsibilities	Total sample (n=100)	
	No.	%
Agency responsible for supervision		
Department supervisor	2	2
Infection control team	66	66
Department supervisor and infection control team	25	25
Department supervisor and infection control team and head nurse	1	1
I do not know	6	6
Other barriers		
Decrease number of nurses	28	28
Lack of supplies	24	24
Presence of family members.	1	1
Doctor tell	1	1
Lack of Cooperate	9	9
The concentration of antiseptic substance:		
Ismalia hospitals (university –general) 10 cm chlorine + 990 cm water		
Zagazig hospitals (university –general) 20cm chlorine +980 cm water		

6. Discussion

Protection from infection within health care institutions is the responsibility of individuals and organizations. The united nation made its effort to improve maternal health by enrolling it as the Millennium Development Goals (MDGs). The urgency to make progress towards reaching the MDGs has led to the fast-tracking of strategies to improve the uptake of delivery care with skilled health professionals. Thus, the worldwide escalation of infection control standards will endorse the quality promotion of health care that is safe for mothers, newborns, and health care personnel in the labor unit *(Mehta et al., 2011)*.

The current study aimed to assess nurses' practice regarding infection control measures during the second stage of labor in multiple centers.

The study was conducted on 100 nurses working in the labor room; more than half were aged 19-< 29 years old. Near half of them had technical education. Around half of the studied nurses had >5 years of experience. These findings reflecting the young age, middle education, and reasonable experience of the study sample. This finding is similar to *(Musa 2017),* who revealed that half of the study sample had 6-10 years of experience in their current position during studying the nurses' knowledge and performance regarding infection control in the labor room in Omdurman Military Hospital, Khartoum State, Sudan.

Also, this study reveals that nearly half of the studied nurses attended infection control courses monthly. This finding might be due to the studied hospitals set part of the salary according to the attendance of educational courses and periodic evaluation. This finding is contradicted to *Shaalan (2018),* who showed that more than three-quarters of nurses did not have any training courses during studying the knowledge of nursing staff towards infection control measures in the delivery room, which in turn increases the risk on both patients and nurses for infection.

The current study reveals that most of the studied nurses had vaccinated against viral hepatitis but did not do periodic checkups because the vaccine is available for free and accentuated by all health care agency particularly for nurses who handle blood and patient excreta, on the other hand, there is no free staff periodical checkup. The study of *(Shaalan 2018)* disagrees with the current study findings that only about one-third of the studied nurses had vaccinated against HBV and agreed with the current study did not make periodical examination before or during work.

The current study demonstrates a total mean score of nurses' practices regarding infection control in delivery rooms of 29.86±4.47 with a mean percentage of 67.883, which is considered a satisfactory level of practice according to the scoring system of the current study. The highest mean percentage for nursing practice was for perineal care done correctly by all nurses, followed by invasive devices in the labor and delivery room, preparing the birthing room and its equipment, and handwashing. Those procedures were considered a core for delivery room nurses and always emphasized by the infection control policy and infection control team during supervision. A low mean percentage was revealed for wearing personal protective equipment, followed by scrub for vaginal delivery. This finding might be due to nurses' shortage as mentioned by more than one-quarter of the nurses, lack of supplies as reported by around one-quarter of them. In contrast, a study conducted in Iran about infection control practices and program management in labor and delivery units revealed that more than two-thirds were recorded the highest mean percentage scores for normal vaginal deliveries hand scrub *(Tabatabaei et al., 2016)*.

The current study reveals a non-statistically significant difference between Ismailia and Zagazig hospitals' total infection control practice, which reflected a similarity in infection control practices between the current study centers. The study also reveals a non-statistically significant difference between the total infection control practice in the university hospitals in Zagazig and Ismailia with a statistically significant difference between Ismailia and Zagazig university hospitals regarding preparing birthing room and its equipment and using invasive devices during Labor. On the other hand, there is no statistically significant

difference between total infection control practice in Ismailia and Zagazig general hospitals except for handwashing. This result may be due to the different priorities of infection control teams in hospitals.

In the current study, most nurses have a satisfactory total infection control practice. This finding might reflect the meticulous supervision from the infection control team, periodic evaluation for nurses' practice and delivery room environment, continuous training, reasonable nurses' experience in the delivery rooms. This finding contrasts with *(Benita 2014),* who revealed that all infection control practices during labor and birth were fair practice level.

The current study result shows that all nurses in Zagazig general hospital had satisfactory practice. Most of the nurses in Ismailia university and Zagazig university hospitals had satisfactory infection control practice. In contrast, more than two-fifth of Ismailia general hospital nurses had satisfactory practice. This finding is because Zagazig General Hospital had only one emergency day per week for delivery, decreasing the workload for the rest of the week. In contrast, the Ismailia General Hospital had maintenance and repairs in their building, which hinder the optimal achievement of infection control standards.

Regarding the physical barriers, the studied nurses in the university hospitals were reported the presence of a hand wash basin with water was located inside the room while outside the room in the general hospitals. Similarly, *Habeeb-Allah's (2011)* results showed that sinks inside the LR were unavailable in one-fifth of the studied hospitals due to insufficient infrastructure resources.

In the current study, nurses confirm the presence of liquid soap in all studied hospitals. The availability of resources might be the reason behind the satisfactory infection control nurses' practice in this study, as the available resources helped them for better practice. This finding disagrees with the study of *Habeeb-Allah (2011),* which showed that soap was not available in half of the investigated sites, which hinders hand washing and maintaining optimal levels of infection control. Also, the delivery room floor and walls of the studied hospital were Ceramic except for the delivery room wall in Ismailia university hospital. Ceramic is one of the basic measures to control infection in the labor room because it can be cleaned easily.

Air conditioners exist in all studied hospitals except Ismailia general hospital due to building maintenance. Similarly, water resource was available in all studied hospital availability of water support infection control dramatically. Whereas *(Tabatabaei et al., 2016)* revealed that only half of the facilities had 24-hour running water.

The working autoclave has existed in all studied hospitals. Also, a working electric oven has existed only in Zagazig hospitals because it has been replaced with an autoclave. This finding is similar to *Musa (2017),* who showed that sterilization equipment such as autoclaves, thermometers are available. In contrast, the study of *(Habeeb-Allah, 2011)* revealed improper and inadequate equipment for sterilization because hot air ovens were not available in more than one-sixth of his studied hospitals.

Clorox, alcohol, betadine, and quantities of sterile gloves were available in all studied hospitals except Zagazig general hospital, which had a shortage as more than one-quarter of the nurses reported the shortage in sterile gloves in Zagazig general hospital. Also, most of the studied nurses reported that hospitals provided overhead for nurses. In contrast to this, eye google was not available in most of the studied hospitals. Mask and apron were available in all studied hospitals while overshoes were available in half of the studied hospitals and clean towel was available for only two-fifth of studied nurses in Zagazig university hospital.

The results of this study reveal that containers for different wastes and safety boxes were available in all hospitals. Waste separation is very important in infection control measures. This finding agrees with *Tabatabaei et al. (2016)*, who revealed that containers for different wastes were available. On the other hand, this disagrees with *Musa (2017),* who revealed that the mean of practice regarding medical waste disposal was poor (only one-quarter of the studied sample were practice well).

Regarding the organizational barriers, most nurses' answers reveal an infection control team inside the delivery rooms in Ismailia and Zagazig hospitals. This periodical assessment obligates nurses to follow all means of infection control and reduce mistakes. Also,*(Tabatabaei et al., 2016)* was in the same line as an infection control team was present inside the delivery rooms in the studied hospital.

Most of the studied nurses report that they had policies and a guidebook on infection control policies and methods, and it is available for all members of the health team. The guidebook helps nurses with frequent review of infection control measures. This finding agrees with *(Tabatabaei et al., 2016),* who find that infection control protocols were in place. On the other hand, *Musa (2017)* revealed that infection control guidelines, protocols, and labor room policies and procedures are unavailable. The stickers and indicative pane concerning infection control were mostly unavailable. especially when regarding stickers to treat the infections

Also, most of the nurses reported that the safety box was disposed of after three-quarters have been filled in the great majority of studied hospitals to decrease the spread of infection, which in contrast with *Tabatabaei et al. (2016),* who revealed that only half of the study sample disposed of safety box when 3/4 full.

The current study reveals that the delivery room in studied hospitals was cleaned periodically from the ceiling to the floor, as reported by most nurses. Besides, all nurses reported that they use antiseptics in cleaning. This finding is similar to *(Tabatabaei et al., 2016),* who reported that the study setting had protocols for cleaning at all times, and all hospitals were used antiseptics in cleaning. Also, the infection control committee was in all hospitals for continuous assessment to achieve infection control measures. This finding is similar to *(Tabatabaei et al., 2016),* who revealed that All of the maternity units reported that they had infection control committees. While *Habeeb-Allah (2010)* revealed that the infection control committee

was found in near two-thirds of labor rooms in the health facilities under the study, there was no apparent activity for this committee in the labor rooms.

Only one-tenth of nurses' answers in the current study shows a system for recording hospital-acquired infections for the employees of the delivery rooms because there are no periodical checkups for employees. This finding disagrees with *Tabatabaei et al.'s (2016)* outcomes, showing that three-quarters of hospitals had employee infection screening. Also, nurses' answers in this study showed that closing labor rooms to prevent transmission of infection was more than two-thirds in Ismailia hospitals while it was around one-tenth in Zagazig general hospital. Closing labor room which contained infected cases is important to decrease transmission of infection until adequate use of disinfectant.

There was a statistically significant difference between Ismailia and Zagazig hospitals in physical barriers at p 0.000. Moreover, there was a statistically significant difference between Ismailia and Zagazig general hospitals in organizational barriers (p=0.026). This difference might be due to some infrastructure differences in the studied hospitals as the wall of the labor room of Ismailia university hospital was not ceramic, and Ismailia general hospital had building maintenance. In comparison, there is a non-significant difference between Ismailia university hospital and Zagazig University Hospital regarding organizational barriers (p=0.47). This finding might be because the university hospitals are governed by the Ministry of Higher Education that administers these hospitals with the same policy and logistics.

In summary, the results of this study suggested that powering the staff nurses with training and directing is mandatory for continuous quality improvement regarding the infection control system.

7. Conclusion

Based on the finding of this study was concluded that most of the studied nurses had a satisfactory level of infection control practices in the delivery room. The study also reveals a similarity in infection control practices between the four studied centers with a non-significant difference between them. According to the infection control audit, most hospitals are equipped with the necessary infection control supplies and are well established. One-quarter of the nurses reported the nursing shortage and lack of supplies as additional barriers to infection control practices.

8. Recommendations

Based upon these study findings, the following can be recommended:
- Upgrading knowledge and qualification of nurses at the labor rooms according to the new evidence.
- Emphasizing the pre-employment medical examination, investigation, and immunization for all nurses at labor room against important infection especially hepatitis B and C, in addition to a periodic medical checkup.

- Guideline for a family member to present in waiting area outside labor department to avoid hinders workflow.
- Provide sufficient medical supplies and equipment of infection control precautions at labor rooms to ensure better nurse's practice.
- Recruit an adequate number of nurses for labor rooms.
- Infection control policies, guidelines, and instructions should be written, e.g., posters in labor rooms about infection control policies and procedures, especially during the covid-19 era.
- Further research to discover the relation between practices and barriers regarding infection control measures.

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