

Original Article

Infection Control Knowledge and Practices of Obstetricians during Normal Labor in Maternity Hospitals in Alexandria: An Intervention Study

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Abstract

Background: Infections during labor and the puerperium are among the leading causes of maternal mortality and morbidity worldwide, accounting for about one tenth of the global burden of maternal deaths. The infection risk associated with care in labor rooms is probably quite high.

Objective(s): The study was conducted to assess infection control (IC) knowledge and practices of obstetricians in maternity hospitals in Alexandria during normal labor and to design, implement and evaluate the effect of an intervention program on IC practices of obstetricians.

Methods: A cross-sectional study design was conducted among 135 obstetricians followed by an intervention study (one group pretest-posttest design). All obstetricians were asked to fill a questionnaire for assessment of knowledge and were observed three times using a checklist for assessment of practice. A health education program was designed and implemented among obstetricians then practices of obstetricians were reassessed using the same checklist.

Results: Nearly 90% of obstetricians in this study had a good level of knowledge regarding standard IC precautions. Nearly two thirds of obstetricians (65.9%) had poor level of practice while 34.1% had fair level of practice pre-intervention. Post-intervention, 46.7% of obstetricians had fair level of practice. Areas of poor practice were hand hygiene and use of PPE. The best area of improvement in post-intervention was hand hygiene while use of PPE did not improve much.

Conclusion: There is a gap between knowledge of obstetricians regarding IC and their practices.

Keywords: Obstetricians, infection control, knowledge and practices, standard precaution

Available on line at:

jhiphalexu.journals.ekb.eg

Print ISSN: 2357-0601

Online ISSN: 2357-061X

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Suggested Citations: Wahdan IH, Elsayed DA, Ibrahim HK. Infection control knowledge and practices of obstetricians during normal labor in maternity hospitals in Alexandria: An intervention study JHIPH. 2019;49(3):133-143.

INTRODUCTION

Infections during labor and the puerperium are among the leading causes of maternal mortality worldwide, accounting for about one tenth of the global burden of maternal deaths.^(1,2) Apart from deaths and acute morbidities associated with infections during or following childbirth, long-term disabilities such as chronic pelvic pain, fallopian tube blockage and secondary infertility can also occur.⁽³⁾

Maternal infections around childbirth also have a considerable impact on newborn mortality.⁽³⁾ Around 1.5 million annual neonatal deaths occur in the first week of life, and infections represent one of the major causes in developing countries. Neonatal sepsis is often strictly connected to infection of the maternal genital tract during labour.⁽⁴⁾ Women die as a result of complications during and following pregnancy and childbirth. The major complications that account for

nearly 75% of all maternal deaths are severe bleeding (mostly bleeding after childbirth), infections (usually after childbirth), high blood pressure during pregnancy (pre-eclampsia and eclampsia), and unsafe abortion.⁽⁵⁾

In line with the target of Sustainable Development Goal 3 (SDG3), to ensure healthy lives and promote well-being for all at all ages, and the new Global Strategy for Women's, Children's and Adolescents' Health (2016-2030), global agendas are expanding their focus to ensure that women and their babies not only survive labor complications if they occur, but also that they thrive and reach their full potential for health and life.⁽⁶⁾

Infections acquired in the health care settings have emerged as an important public health problem worldwide and are a leading cause of morbidity and mortality in developed and developing countries. Although the duration of contact with the facilities is generally brief, the infection risk associated with care

in labor rooms is probably quite high.⁽⁷⁾ So, a properly assisted delivery with skilled personnel and following infection control (IC) precautions is highly advantageous to both mother and foetus during delivery.⁽⁸⁾

In order to achieve reduction in infection rates among patients and staff, an infection prevention and control program is needed. There is an evidence and rationale to support the notion that participation of trained IC professionals in health care facilities is associated with better results if adherence with IC precautions is ensured.⁽⁹⁾

The objectives of this study were to assess the knowledge of obstetricians in maternity hospitals regarding IC, to assess the actual IC practices of obstetricians during normal labor, and to design, implement and evaluate an intervention program for IC according to the results obtained from observation of the practices of obstetricians in labor rooms.

METHODS

The study was conducted in labor rooms of the obstetric wards of El Shatby University Hospital and Dar Ismael Hospital, a Ministry of Health and Population hospital in Alexandria Governorate. These two hospitals were selected because they provide delivery services to a large number of pregnant women from Alexandria and nearby Governorates. The study design was a cross-sectional study followed by an intervention study (one group pretest-posttest design).

For assessment of knowledge and IC practices, all obstetricians (100 from Dar Ismael hospital and 35 from El Shatby hospital) were included. For assessment of practice, they were observed three times taking into consideration representation of different shifts giving a total number of 405 observations. For the intervention program, all obstetricians were included.

The data collection tools were prepared by the researchers based on the National Guidelines for Infection Control of the Egyptian Ministry of Health and Population (2016).⁽¹⁰⁾ A predesigned self-administered structured questionnaire was used to assess knowledge of obstetricians regarding IC. For assessment of practice, an observation checklist for IC practices was used. The questionnaire included the personal characteristics of obstetricians (age, sex, educational level, job title, years of experience, and attended training sessions on IC). Knowledge of obstetricians was assessed regarding standard IC precautions. The following items were assessed and scored: Knowledge about standard IC precautions, knowledge about hand hygiene and its timing, knowledge about personal protective equipment (PPE) (type and timing of using gloves, using and changing masks, using protective eyewear, sterile gowns and

boots). In addition to dealing with contaminated surfaces, linen and used instruments, and appropriate method for dealing with body fluid spills and for disposal of waste.

A scoring system was prepared and applied by the researchers. Correct answer was scored "one" and incorrect answer and/or do not know were scored "zero". The total knowledge score was calculated by summing scores of all questions (27 items). The level of knowledge was classified as: good ($\geq 75\%$, ≥ 20 points), fair (50 - $< 75\%$, 14 - < 20 points) and poor ($< 50\%$, < 14 points).

The checklist for IC practices included: Hand hygiene (type and technique); PPE including timing of use of gloves (using a new pair of gloves for each woman, changing gloves), using face and eye protection, using protective clothing during labor and wearing boots during labor. It also included cleaning, sterilization and disinfection of equipment (using a sterile set of equipment for each woman, scrubbing the perineal area with antiseptic solution downward and backward motion, using hands free technique to pass or transfer sharps, using an antiseptic agent to clean umbilical cord prior to clamping, fixing the cannula under aseptic technique, immersing used instruments in a container full of soap and water or disinfectant prior to their processing. Waste management (disposing sharps and non-sharps) was also assessed.

To calculate the percentage of practice score, another scoring system was prepared and applied by the researchers. For each of the 405 observations, correct practice was scored "one" and incorrect one was scored "zero". The total score of practice (43 items) was calculated by summing scores of all observations. The level of practice was classified as: good when the score was $\geq 75\%$ (≥ 32 points), fair when it was 50 - $< 75\%$ (22 - < 32 points) and poor when it was $< 50\%$ (< 22 points).

An intervention program was designed by the researchers according to the results obtained from the preliminary/assessment phase. The program was tailored according to the needs of the obstetricians. Then, it was implemented by the researchers over a period of two months in the educational rooms of both hospitals. The educational methods consisted of lectures, discussions and demonstrations. Educational materials as PowerPoint presentations, videos, posters and booklets about IC were used. The educational program was implemented in four sessions. The first session was on definition of IC and its importance. The second was on definition and types of standard precautions and definition, types and technique of hand hygiene. The third included definition and types of PPE. The fourth session was about cleaning, disinfection and sterilization. It also included the waste management. Each session was around 30-45 minutes. Six weeks after the end of the intervention program, the practices of the obstetricians in the labor

rooms of the obstetric wards were reassessed using the same checklist.

Statistical analysis

Data were revised, checked for completion and coded. The SPSS program version 21 was used for data analysis. The mean and standard deviation were used as descriptive measures. Chi square, Monte Carlo's Exact, and Wilcoxon tests were used as tests of significance. Differences at p -value ≤ 0.05 were considered statistically significant. Logistic regression analysis was conducted to determine the predictors that affect the total post intervention practice score of obstetricians, estimated by the Odds ratio and the 95% confidence interval. The variables included in the regression model were the factors that were significant in the bivariate analysis. The Receiver Operating Characteristic (ROC) curve for the score was also graphically drawn.

Ethical considerations

The researchers sought the approval of the Ethics Committee of the High Institute of Public Health, Alexandria University for conduction of the study. The researchers complied with the International Guidelines for Research Ethics. Verbal consent was taken from obstetricians after explanation of the objectives and benefits of the study. Anonymity and confidentiality of data were assured and maintained.

RESULTS

Personal characteristics of obstetricians

Table 1 shows the distribution of the obstetricians according to their personal characteristics by hospital. The age of obstetricians ranged between 26 and 42 years with mean age of 29.85 ± 3.46 years. Obstetricians in El Shatby Hospital were younger than those of Dar Ismael Hospital. The difference in age was statistically significant ($p = 0.036$). More than half (52.6%) of obstetricians were males and 47.4% were females. There were more females in Dar Ismael Hospital were males and the reverse in El Shatby Hospital. The difference was statistically significant ($p=0.028$). As regards level of education, 77.8% had only a Bachelor degree and 22.2% had Master degree. There were more with master degree in Dar Ismael Hospital, a difference that was statistically significant ($p= 0.024$). The mean years of experience was 2.81 ± 4.60 years and was slightly more in Dar Ismael obstetricians than El Shatby obstetricians but the difference was not statistically significant ($p= 0.533$). Nearly half (48.9%) of obstetricians attended training programs related to IC. The percent of those who attended training in Dar Ismael were higher than in El Shatby. However, the difference was not statistically significant ($p= 0.127$).

Table 1: Distribution of the obstetricians according to their personal characteristics, Dar Ismael and El Shatby hospitals, Alexandria, 2017

Personal Characteristics	Dar Ismael (n=100)		El Shatby (n=35)		Total (n=135)		Test of significance
	n	%	n	%	n	%	
Age (in years)							
25-	54	54.0	27	77.1	81	60.0	$\chi^2 = 5.958$ $p = 0.051^*$
30-	38	38.0	6	17.1	44	32.6	
35+	8	8.0	2	5.7	10	7.4	
Mean \pm SD	30.22 \pm 3.38		28.80 \pm 3.52		29.85 \pm 3.459		$t = 2.117$ $p = 0.036^*$
Sex							
Male	47	47.0	24	68.6	71	52.6	$\chi^2 = 4.839$ $p = 0.028^*$
Female	53	53.0	11	31.4	64	47.4	
Qualifications							
Bachelor degree	73	73.0	32	91.4	105	77.8	$\chi^2 = 5.094$ $p = 0.024^*$
Master degree	27	27.0	3	8.6	30	22.2	
Years of experience							
<1	20	20.0	12	34.2	32	23.7	$\chi^2 = 0.388$ $p = 0.114$
1-	72	72.0	21	60.0	93	68.9	
10-	5	5.0	1	2.9	6	4.4	
20+	3	3.0	1	2.9	4	3.0	
Mean \pm SD	2.96 \pm 4.72		2.39 \pm 4.27		2.81 \pm 4.60		$t = 0.625$ $p = 0.533$
Attending training programs related to IC							
Yes	55	55.0	14	40.0	66	48.9	$\chi^2 = 2.334$ $p = 0.127$
No	45	45.0	21	60.0	69	51.1	

*Significant at $p \leq 0.05$

MC: Monte Carlo exact probability in case of invalid chi-square

Knowledge of the obstetricians regarding IC

Table 2 shows the distribution of obstetricians in both hospitals by their knowledge about IC. The majority of obstetricians (89.6%) in both hospitals had knowledge about the standard IC precautions. It is satisfactory to note that all obstetricians in both hospitals were able to mention types of IC precautions.

Regarding knowledge of obstetricians about hand hygiene, the majority (93.3%) had knowledge about the steps of hand washing. Concerning timing, most of obstetricians (94.8%) mentioned that hands should be washed before and after dealing with the patients (correct answer). Nearly three quarters of obstetricians (73.3%) mentioned that hands should be washed before and after any invasive procedure (correct answer) and 61.5% stated that hands should be washed after removing gloves (correct answer). Washing hands when they are soiled or visibly dirty (correct answer) was mentioned by 72.6% of obstetricians and 67.4% mentioned that hands should be washed before leaving the labor room (correct answer). The differences between the two hospitals show that the

knowledge of obstetricians is significantly better in Dar Ismael Hospital than El Shatby Hospital (MCp= 0.058).

Concerning knowledge of obstetricians about PPE, all obstetricians had good knowledge about the PPE and their types. As well, all of them stated that gloves should be used during normal labor. About three quarters of obstetricians knew the appropriate type of gloves used during vaginal examination which is non-sterile gloves and knew the appropriate type of gloves used during normal labor which is sterile gloves. Regarding timing of using gloves, 88.9% of obstetricians mentioned that gloves should be used before dealing with the patient (correct answer) and 47.4% mentioned changing gloves, when dealing with another patient (correct answer).

Only 38.5% of obstetricians mentioned that masks should be worn during normal labor and should be changed between patients (correct answer) and nearly one quarter of obstetricians (25.2%) mentioned that protective eyewear should be worn during normal labor (correct answer).

Table 2: Distribution of obstetricians according to their knowledge regarding infection control, Dar Ismael and El Shatby hospitals, Alexandria, 2017

Knowledge items	Dar Ismael (n= 100)		El-Shatby (n= 35)		Total (n=135)	
	n	%	n	%	n	%
Standard IC precautions	90	90.0	31	88.6	121	89.6
◆ Hand hygiene						
Steps	96	96.0	30	85.7	126	93.3
Timing: Before and after dealing with patients	96	96.0	32	91.4	128	94.8
Before and after invasive procedures	79	79.0	20	57.1	99	73.3
After removing gloves	71	71.0	12	34.3	83	61.5
When soiled	79	79.0	19	54.3	98	72.6
Before leaving the labor room	75	75.0	16	45.7	91	67.4
◆ PPE						
Use of PPE	100	100.0	35	100.0	135	100.0
Use of gloves	100	100.0	35	100.0	135	100.0
Type						
Sterile during normal labor	80	80.0	25	71.4	105	77.8
Non sterile during vaginal examination	75	75.0	26	74.3	101	74.8
Timing						
Before dealing with patient	87	72.5	33	94.3	120	88.9
When dealing with another	46	71.9	18	51.4	64	47.4
Use of masks	36	36.0	16	45.7	52	38.5
Wearing protective eyewear	25	25.0	9	25.7	34	25.2
Wearing sterile gowns	65	65.0	28	80.0	93	68.9
Use of boots	86	86.0	31	88.6	117	86.7
◆ Disinfection and sterilization						
Washing contaminated surfaces	90	90.0	27	77.1	117	86.7
Washing contaminated linen	81	81.0	24	68.6	105	77.8
Cleaning then sterilizing used equipment	94	94.0	29	82.9	123	91.1
◆ Waste management						
Disposal of needles in safety boxes	100	100.0	35	100.0	135	100.0
Disposal of syringes without recapping	71	71.0	26	74.3	97	71.9
Disposal of non-sharps in specific bags	85	85.0	24	68.6	109	80.7

About two thirds (68.9%) of obstetricians mentioned that sterile gowns should be worn during normal labor (correct answer) and 77.8% stated that gowns should be taken off before leaving labor room (correct answer). The majority of obstetricians (86.7%) knew that boots should be used.

Regarding disinfection and sterilization, 86.7% of obstetricians mentioned that contaminated surfaces after normal labor should be washed with water and mixture of detergent and chlorine solution then should be dried (correct answer). About three quarters (77.8%) of obstetricians stated that contaminated linens after normal labor should be washed with water and mixture of detergent and chlorine solution then should be dried (correct answer). The majority of obstetricians (91.1%) knew that contaminated used instruments after normal labor should be washed with water and detergent then should be sterilized (correct answer). More than half of obstetricians (54.1%) stated that blood or anybody fluid spills should be wiped with dry paper towel, then cleaned with water and mixture of detergent and chlorine solution then dried (correct answer).

Concerning knowledge of obstetricians about waste management, all obstetricians stated that sharp objects as needles must be disposed in safety boxes

(correct answer) and 71.9% mentioned that syringes must be disposed without recapping (correct answer). More than three quarters of obstetricians (80.7%) stated that non-sharps must be disposed in specific colored bags (correct answer). Obstetricians in Dar Ismael gave significantly more correct answers ($\chi^2=4.500, p=0.034$).

Table 3 shows the distribution of the obstetricians according to their level of knowledge regarding IC. All obstetricians in both hospitals had good level of knowledge regarding standard IC precautions. The table shows that 23.7% had poor level of knowledge regarding hand hygiene. The table also shows that all obstetricians had good level of knowledge regarding PPE. It also appears from the table that only 5.9% of obstetricians had poor level of knowledge regarding disinfection and sterilization. Obstetricians in Dar Ismael had significantly better knowledge than those of El Shatby ($\chi^2=13.715, p=0.001$).

The table also illustrates that 55.6% of obstetricians had good level of knowledge regarding waste management and only 3.0% had poor level of knowledge. Overall, it appears from the table that all obstetricians in El Shatby Hospital and 94.0% of obstetricians in Dar Ismael Hospital had good level (scored more than 75%) of knowledge.

Table 3: Distribution of the obstetricians according to their level of knowledge regarding infection control, Dar Ismael and El Shatby hospitals, Alexandria, 2017

Knowledge scores	Dar Ismael (n= 100)		El-Shatby (n= 35)		Total (n=135)		Test of significance
	n	%	n	%	n	%	
◆ Standard IC Precautions							
Good	100	100.0	35	100.0	135	100.0	
◆ Hand hygiene							
Good	75	75.0	21	60.0	96	71.1	$\chi^2= 3.055$ $p=0.217$
Fair	4	4.0	3	8.6	7	5.2	
Poor	21	21.0	11	31.4	32	23.7	
◆ PPE							
Good	100	100.0	35	100.0	135	100.0	
◆ Disinfection and sterilization:							
Good	83	83.0	18	51.4	101	74.8	$\chi^2=13.715$ $p=0.001^*$
Fair	13	13.0	13	37.2	26	19.3	
Poor	4	4.0	4	11.4	8	5.9	
◆ Waste management:							
Good	57	57.0	18	51.4	75	55.6	$\chi^2=4.468$ $p=0.106$
Fair	42	42.0	14	40.0	56	41.4	
Poor	1	1.0	3	8.6	4	3.0	
◆ Total knowledge score							
Good	94	94.0	35	100.0	129	95.6	$\chi^2=2.181$ $p=0.198$
Fair	6	6.0	0	0.0	6	4.4	

*Significant at $p \leq 0.05$

Infection control practices of obstetricians

Table 4 shows the observations made on IC practices of obstetricians in both hospitals. Regarding hand hygiene observations for obstetricians, hands were washed when soiled or visibly dirty in 74.8% of the observations. Hands were washed before donning gloves in only 8.1% of observations. Hands were washed immediately after removing gloves in 86.2% of the observations. Hands were washed using soap and water or Povidone-Iodine (Betadine 7.5%) in 68.8% of the observations. In only 9.6% of the observations, rings were removed before washing hands. Hands were rubbed up to elbow and residual soap was removed under running water in 54.8% of observations and in only 9.4% of observations, hands were washed without missing webs between fingers, finger nails, thumbs, and dorsum of fingers. Tap was turned off without touching it in 33.8% of the observations. Hands were dried using disposable tissue paper in 36.0% of the observations.

Concerning PPE observations, it is noted that in all observations, clean disposable gloves were used during vaginal examination and new pairs of gloves were used for each woman. Sterile gloves were used for delivery in 47.4% of observations and for handling the newborn in 45.4% of the observations.

Concerning timing of changing gloves, in 77.8% of the observations, gloves were changed immediately after use. Gloves were changed when going from a dirty to a clean area in 27.7% of the observations. Also, gloves were changed when soiled in 32.6% of the observations. However, in all observations in both hospitals, gloves were not changed during moving from a contaminated to a clean body site of the same woman.

As regards face and eye protection, masks were used before labor in only 12.6% of the observations. Among those using masks, they were changed between women in all observations and in 43.1% of the observations, masks covered both the nose and mouth. In all observations in both hospitals, protective eyewear and face shield were not used. The table also illustrates that, gowns were used during labor in 42.7% of the observations. As regards type of gowns, 36.4% were sterile and 63.6% were plastic Machintosh. Boots were used during labor in all observations of Dar Ismael Hospital and were not used in any observation in El Shatby Hospital. This difference was highly significant ($\chi^2=4.050, p<0.001$).

Concerning disinfection and sterilization, in all observations in both hospitals, a sterile set of equipment and obstetric instruments were used for each woman. In 26.4% of the observations, the perineal area was scrubbed with antiseptic solution using downward and backward motion. In about three quarters of the observations (73.6%), moving away from the delivery room and touching other

environmental surfaces while donning gloves was not done. In all observations in both hospitals, the obstetricians did not use an antiseptic agent to clean the umbilical cord prior to clamping.

Regarding waste management, table (4) shows that in 45.9% of the observations, sharps were disposed in safety boxes. The table also illustrates that needles were not recapped in 77.0% of the observations. In all observations in both hospitals, needles were not bent or reused. Also, in all observations in both hospitals (100.0%), placenta was disposed in specific labeled colored bag.

Intervention program

Observations of the obstetricians showed significant improvement in IC practice post intervention compared to pre-intervention. There was a highly significant difference between the level of practice pre and post intervention ($p<0.001$) (Figure 1).

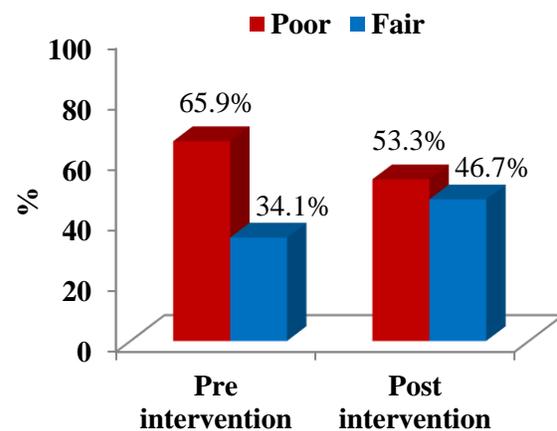


Figure 1: Distribution of obstetricians according to their level of infection control practice pre and post intervention in both hospitals, Alexandria, 2017

The mean total percentage of practice score regarding IC among doctors was 47.80 ± 7.999 before intervention and 50.24 ± 7.282 after. This difference was significant ($t=5.589, p=0.000$). In both hospitals, pre and post intervention mean score with respect to hand hygiene, PPE and waste management improved. There was also improvement in disinfection and sterilization in Dar Ismael Hospital. The percent change of hand hygiene was the highest one (20.54%), while the lowest one was in the use of PPE (1.91%) (Table 5).

Logistic regression analysis of the factors affecting the level of practice of doctors regarding IC after intervention shows that level of practice before the intervention and the qualification were the predictors of good practice. Those with fair and good practice before the intervention had 115.357 times higher probability to get better practice compared to

the poor. Those with bachelor degree had 0.147 times lower probability to get high level of practice than those who have master degree. (Table 6). It could be noted that the two variables that were significant in the bivariate analysis kept their significance after

multivariate adjustment. The ROC curve of probability of good practice score about IC was calculated from binary logistic regression model among doctors. The area under the curve (AUC) was 0.875 (CI= 0.8–0.9 and $p < 0.001$) (Figure 2).

Table 4: Observations of infection control practices of obstetricians, Dar Ismael and El Shatby hospitals, Alexandria, 2017

Practice items	Dar Ismael		El-Shatby		Total	
	(n= 300)		(n= 105)		(n= 405)	
	n	%	n	%	n	%
♦ Hand hygiene						
Washing hands when visibly soiled	206	68.7	97	92.4	303	74.8
Washing hands before donning gloves	30	10.0	3	2.9	33	8.1
Washing hands after removing gloves	253	84.3	96	91.4	349	86.2
Rings removed before washing	33	11.0	6	5.7	39	9.6
Hands rubbed up to elbow	157	52.3	65	61.9	222	54.8
Hands washed without missing webs	30	10.0	8	7.6	38	9.4
Hands dried with disposable tissue paper	123	41.0	23	21.9	146	36.0
♦ PPE						
Non-sterile gloves used for vaginal examination	300	100.0	105	100.0	405	100.0
New pair of gloves used for each woman	300	100.0	105	100.0	405	100.0
Sterile gloves used for delivery	117	39.0	75	71.4	192	47.4
Sterile gloves used before handling newborn	137	45.7	47	44.8	184	45.4
Gloves changed immediately after use	235	78.3	80	76.2	315	77.8
Gloves changed when moving to clean area	83	27.7	29	27.6	112	27.7
Gloves changed when soiled	98	32.7	34	32.4	132	32.6
Use of masks before labor	41	13.7	10	9.5	51	12.6
Wearing protective eyewear and face shield	0	0.0	0	0.0	0	0.0
Wearing gowns	159	47.7	30	28.6	173	42.7
Use of boots	300	100.0	0	0.0	300	74.1
♦ Disinfection and sterilization						
Use of a sterile set of equipment	300	100.0	105	100.0	405	100.0
Disinfecting perineal area with antiseptic	77	25.7	30	28.6	107	26.4
Touching a non-sterile area while donning gloves is not done	220	73.3	78	74.3	298	73.6
♦ Waste management						
Disposal of sharps in safety boxes	132	44.0	54	51.4	186	45.9
Needles not recapped	233	77.7	79	75.2	312	77.0

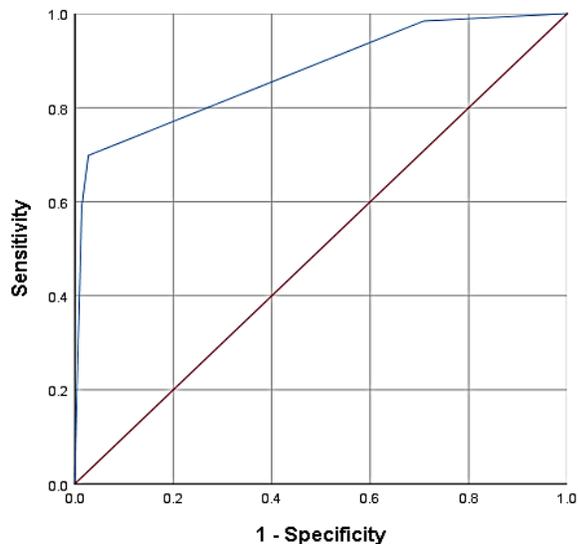
Table 5: Distribution of obstetricians according to their mean infection control practice scores pre and post intervention, Dar Ismael and El Shatby hospitals, Alexandria, 2017

Scores of practice	Dar Ismael		Wilcoxon test	%	El Shatby		Wilcoxon test	%	Total		Wilcoxon test	%
	Pre	Post			Pre	Post			Pre	Post		
	Mean±SD	Mean±SD			Mean±SD	Mean±SD			Mean±SD	Mean±SD		
Hand hygiene	41.70	50.20	-6.313	20.38	38.00	46.00	-4.007	21.05	40.74	49.11±	-7.455	20.54
	±	±	$p=0.000^*$		±	±	$p=0.000^*$		±16.734	17.254	$p=0.000^*$	
PPE	17.58	17.75	-2.807	4.68	13.89	15.57	-1.686	6.01	42.32	43.13	-1.374	1.91
	±	±	$p=0.005^*$		±	±	$p=0.092$		±9.529	±10.665	$p=0.169$	
Disinfection and sterilization	9.419	10.464	-2.683	4.4	11.105	9.878	-0.816	2.22	44.93	46.66	-2.746	3.85
	±	±	$p=0.007^*$		±	±	$p=0.414$		±11.567	±10.927	$p=0.006$	
Waste management	11.57	10.69	-5.24	7.26	11.57	11.39	-2.53	5.23	85.92	91.70	-5.808	6.73
	±	±	$p=0.000^*$		±	±9.94	$p=0.011^*$		±12.713	±10.757	$p=0.000^*$	
Total	12.34	11.08	-4.294	4.42	13.79	50.16	-3.405	7.08	47.80	50.24	-5.443	5.1
	±	±	$p=0.000^*$		±8.556	±7.403	$p=0.001^*$		±7.999	±7.282	$p=0.000^*$	

*Significant at $p \leq 0.05$

Table 6: Logistic regression analysis of the factors affecting the level of practice of doctors regarding IC after intervention

Independent variables	Coefficient β	<i>p</i>	Adjusted Odds ratio (OR)	95% CI	
				Lower	Upper
Level of practice before the intervention (fair and good versus poor)	4.748	0.000	115.357	20.863	637.833
Qualifications (bachelor versus master)	-1.919	0.022	0.147	0.029	0.754
Constant	-3.840	0.000	0.021		

**Figure 2: ROC curve of probability of good level of practice of doctors regarding infection control after the intervention program, calculated from binary logistic regression model**

DISCUSSION

Infections acquired during childbirth are considered a common cause of maternal and perinatal mortality and morbidity. It has been estimated that globally, better care during labor and birth, and care of newborns immediately after birth can avert up to 1.49 million maternal and newborn deaths and still births.⁽¹¹⁾ Infection Control is a most important field of concern in labor and delivery rooms.⁽¹²⁾

It was noticed from the present study that almost 90% of obstetricians in both hospitals had good level of knowledge regarding standard IC precautions. Similar findings were reported in a study done in India (2011) where all doctors had knowledge about standard IC precautions.⁽¹³⁾ On the contrary, a study done in Ghana (2017) revealed that knowledge of Health Care Workers (HCWs) about standard precautions was low.⁽¹⁴⁾ Hand hygiene is a core element of patient safety for the prevention of HAIs and the spread of antimicrobial resistance. In the

present study, the majority of obstetricians had a good knowledge about hand hygiene. This finding is in contrast with a study done in India (2014), where only 9.0% of participants had good knowledge.⁽¹⁵⁾ And another study done in Mashhad, Iran (2017), where only 10.6% of HCWs had a good knowledge about hand hygiene.⁽¹⁶⁾ This may be attributed to the findings that near half of obstetricians attended training programs on IC.

About two thirds of obstetricians mentioned that they wash their hands after removing gloves and more than two thirds of obstetricians knew that washing hands is necessary before leaving the labor room. These results were consistent with those obtained in other studies namely in Maldives/Thailand (2008), 86.0% of HCWs knew that washing hands is important after removal of gloves.⁽¹⁷⁾

Concerning PPE, all obstetricians in this study knew the need to use PPE. All mentioned gloves. The efficacy of gloves in preventing contamination of health-care workers' hands and helping to reduce transmission of pathogens in health care has been confirmed in several clinical studies. In the current study, the majority of obstetricians (88.9%) mentioned that gloves should be used before dealing with any patient and near half of obstetricians mentioned that gloves should be used between patients. The study done in Maldives/Thailand revealed that about 40.0% of HCWs knew that they should wear gloves during performing procedures.⁽¹⁷⁾ It was noticed in the current study that about three quarters of obstetricians used non-sterile gloves for vaginal examination. This finding was in agreement with a study done in India (2011) where in 80.0% of the health facilities included in the study, vaginal examinations in the labor room were conducted with reused, washed or autoclaved gloves or gloves used after simple washing without autoclaving.⁽¹⁸⁾ Also, in the present study, about three quarters of obstetricians mentioned that sterile gloves should be used during normal labor. A study done in Georgia/USA (2010) revealed that three quarters of obstetricians did not determine correctly when sterile versus non-sterile gloves should be used.⁽¹⁹⁾

In the current study, 38.5% of obstetricians reported that masks should be used during normal labor. A study done in Khartoum/Sudan (2009)

reported that near half of HCWs mentioned that masks should be used during labor.⁽²⁰⁾ Also, in the present work, one quarter of obstetricians mentioned that protective eyewear should be used during normal labor. This result was in contrast with the study done in Shebin El-Kom/Egypt (2016), where only 5.7% of obstetricians mentioned that protective eyewear should be used routinely.⁽²¹⁾ About two thirds of obstetricians (68.9%) mentioned that sterile gowns should be used during normal labor. The study done in Shebin El-Kom/Egypt, indicated that all obstetricians mentioned that sterile gowns should be used during normal labor.⁽²¹⁾

In our study, the majority of obstetricians were aware about the disinfection and sterilization needed for contaminated surfaces, linen and equipment. As well, they were aware of the proper method of dealing with waste (needles, syringes and non-sharps). Translating this information into scores, it was noted that obstetricians in both Dar Ismael and El Shatby hospitals had good score (more than 75% correct answers) with respect to their knowledge about standard IC precautions and PPE. More than 70% had good scores of knowledge about hand hygiene and disinfection and sterilization procedures but only 55.6% score with respect to waste management.

As regards observations made, it was noted that in general lower rates were recorded than those of knowledge with regard to hand hygiene. It was noted that obstetricians washed their hands using soap and water and in 68.8% of observations Povidone-iodine (Betadine 7.5%) was used. In a study done in Ethiopia (2016), HCWs washed their hands using soap or other antiseptic solutions.⁽²²⁾ Also, results of the present study showed that obstetricians removed rings before washing hands in 9.6% of the observations. In Shebin El-Kom/Egypt (2016), obstetricians removed rings before washing hands in 28.3% of observations.⁽²¹⁾ Obstetricians rubbed up their hands to elbow and residual soap was removed under running water in more than half of observations. Obstetricians washed hands without missing any areas in 9.4% of observations. Less than one third of observations for obstetricians showed that tap was turned off without touching it. These findings were in agreement with a study done in China (2004), where hand washing technique was not used before performing any procedure.⁽²³⁾ Another study done in Nigeria (2018) showed that 32.5% of HCWs practiced all steps of hand washing technique.⁽²⁴⁾ The current study showed that obstetricians dried their hands using tissue disposable towel in only 36.0% of the observations. These findings were less than findings in a study done in Ethiopia (2016), where 21.0% of the participants used towel for hand drying and 70.0% used air for hand drying.⁽²¹⁾ In a university hospital in Turkey (2005), 79.8% of HCWs didn't dry their hands.⁽²⁵⁾ As

regards timing of hand washing, obstetricians washed their hands immediately after removing gloves in 86.2% of the observations and when soiled or visibly dirty in 74.8% of the observations. In a study done in Egypt (2008), only 3.0% of HCWs applied routine hand washing before removal of gloves and 4.3% applied it after removal.⁽²⁶⁾ In Maldives/Thailand, in the health care settings, more than three quarters (77.6%) of HCWs washed their hands immediately after removing gloves and if obviously soiled.⁽¹⁷⁾

Concerning the use of gloves, it was noticed from the present study that obstetricians used non-sterile disposable gloves during vaginal examination in all observations. These findings were in agreement with a study done in Shebin El-Kom/Egypt (2016) where in all observations disposable latex gloves were used by obstetricians during vaginal examination.⁽²¹⁾

In the current study, obstetricians used sterile gloves during normal labor and before handling the newborn in 47.4%, 45.4% of the observations respectively. These findings were less than results in a study done in Shebin El-Kom/Egypt (2016) where sterile gloves were used during normal labor and before handling the newborn in 63.1% and 68.6% of observations respectively.⁽²¹⁾ A study done in Nigeria (2012), revealed that sterile gloves were used routinely in 90.0% of the observations.⁽²⁷⁾

As regards timing of changing gloves, this was done immediately after use 77.8% of observations. Also, gloves were changed during going from dirt to a clean area in one third of observations. In 32.6% of observations for obstetricians, gloves were changed when soiled. These findings were in agreement with a study done in Zambia (2008) where less than one third of HCWs changed gloves when exposed to blood or other body fluids or when became soiled.⁽²⁸⁾ Also, more than half of HCWs (54.4%) worn them when exposed to blood or other body fluids in Maldives/Thailand (2008).⁽¹⁷⁾ In a study done in Karachi/Pakistan (2009), 56.7% of participant changed gloves for each patient.⁽²⁹⁾

It was noticed from the present study that masks were used by obstetricians before starting normal labor in 12.6% of observations. In Gujranwala/Pakistan (2008) masks were not used during labor.⁽³⁰⁾ Protective eyewear and face shield were not used in the current study. This finding is in agreement with a study done in Karachi/Pakistan (2009) where protective goggles were not used by any participant.⁽²⁹⁾ Another study done in Chandigarh/India (2011) showed that protective eyewear was used by HCWs in 18.4% of the observations.⁽¹³⁾

Regarding compliance of wearing sterile gowns during normal labor, obstetricians used either sterile gowns or plastic Machintosh. In the study done in Shebin El-Kom/Egypt (2016) in 85.4% of observations sterile gowns were used by obstetricians.⁽²¹⁾ In a study done in Chandigarh/India

(2011), disposable plastic aprons were used by HCWs during labor in 34.5% of observations.⁽¹³⁾

In this study, special footwear was worn during normal labor in only Dar Ismael while in El Shatby, no footwears were used. In a study done in Shebin El-Kom/Egypt (2016), boots/foot covers were worn in 92.9% of observations.⁽²¹⁾ The reason for the differences between both hospitals relates to the availability of footwear in the hospital.

Concerning disinfection and sterilization, a sterile set of equipment and obstetric instruments were changed between women in all observations. These findings are similar to findings of a study done in Shebin El-Kom/Egypt.⁽²¹⁾ In the current study, disposal of sharps was done in safety boxes in 45.9% of observations. A study done in Addis Ababa (2018) indicated that HCWs disposed sharps or needles immediately after use in safety boxes in 98.3% of the observations.⁽³¹⁾ Also in a study done in Georgia (2010)⁽⁴⁹⁾ and in Khartoum (2009)⁽²⁰⁾, 63.4% and 62.0% respectively of respondents disposed sharps in a puncture resistant containers.

Comparing knowledge with practice, it was noted that lower rates of practice were observed than those recorded as knowledge for hand hygiene, PPE, and disinfection. In hand hygiene, the observations recorded poor results related to washing hands before donning gloves, removing rings before washing hands and missing webs. In PPE, the observations recording poor results were those related to the use of sterile gloves before handling newborns (45%), use of masks (18%), wearing protective eyewear which was not practiced in any observation and wearing boots which was not practiced in one hospital while always used in the other. This may be due to unavailability of boots. On the other hand, knowledge and practice correspond to each other with regards to waste management but not exactly regarding disinfection and sterilization.

As regards the intervention, table 5 shows that the mean scores of all practices showed an increase in the post-intervention assessment and this increase was statistically significant with respect to hand hygiene, waste management and disinfection and sterilization. The percent change was highest in hand hygiene (>20%) followed by waste management (6.7%) and disinfection and sterilization (3.85%) while it was only 1.91% for PPE. The differences observed relate to the availability of resources in the hospitals concerned.

CONCLUSION & RECOMMENDATIONS

Most obstetricians working in the two hospitals have good knowledge about standard IC precautions. However, the observed practices showed lower rates than the knowledge. This fits with the fact that knowledge does not mean practice partly as the latter is related to some factors such as the availability of resources and suitable environment. It is

recommended therefore that IC should be taken into consideration when developing strategies aiming at improving the maternal health. IC manual should be available for all HCWs. Providing sufficient supply of PPE, safety boxes and disposable syringes and needles is needed. It is also recommended that continuous supervision and evaluation of IC practices of obstetricians be made regularly by the hospital IC team.

Funding: No funding sources

Conflict of Interest: None to declare.

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