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Educational Intervention to Improve adherence to Methicillin-Resistant Staphylococcus Aureus Control Practice Among Nurses at Two Hospitals in Egypt

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Abstract

Purpose: The aim of this study was to evaluate the effectiveness of an educational intervention to improve adherence to Methicillin-Resistant Staphylococcus Aureus control practice among nurses at two Hospitals in Egypt. Methicillin-resistant Staphylococcus aureus (MRSA) is a major pathogen and the most common multidrug-resistant bacterium which is responsible for nosocomial infections, with elevated morbidity and mortality rate. Nurses need a comprehensive intervention to improve adherence to MRSA control practice in order to decrease the rate of its spread.

Research design: Pre /post-quasi-experimental design was used in this study. This study was carried out at two hospitals in Egypt (Mansoura Chest Disease and Benha University Hospital). A convenient sample of 80 nurses. Tool I- Nurses's Structured Interview Questionnaire in Arabic language. Tool II - Observational Checklist for MRSA and Infection Control Practice. Descriptive statistics such as frequencies, means, and standard deviations were used to summarize the data. Chi-square and r (correlation) were used to correlate between the studied variables.

Methodology: Before the application of educational intervention 32.5% of nurses has poor practice levels and the percentage decreased to 7.5%, 14.5 immediately and 2 months post-educational intervention respectively.

Unique contribution to theory, practice and policy: The educational intervention was effective in improving adherence to Methicillin-Resistant Staphylococcus Aureus control practice among nurses at the two hospitals as there is a statistically significant difference between all phases of the study regarding nurses' practice. Emphasizing the importance of following the latest updated evidence-based approaches to infection control in continuing training programs, and infection prevention with national guidelines (standard precautions) should be provided.

Keywords: *Adherence, Educational intervention, Methicillin-Resistant Staphylococcus Aureus, Nurses, Practice.*

Introduction

Healthcare-associated infections (HAIs) are a major problem for the safety of patients and healthcare workers as well and healthcare systems and organizations should consider their prevention as a top priority **(Al-Omari et al., 2020).** Antibiotics are crucial to medical care as they have a significant role in treating infections thus ensuring the success of surgeries. Antimicrobial resistance makes antibiotics lose their efficacy so many resources of health care and treating illness would be affected which threatens human lives in the worst-case scenario **(World Health Organization, 2021)**.

One of the Antimicrobial drug resistance bacterium is Methicillin-resistant Staphylococcus aureus (MRSA) **(Ruotsalainen, 2021**). MRSA is still known as one of the most important nosocomial organisms. These isolates are usually resistant to all currently available β-lactam antibiotics penicillins, cephalosporins, and carbapenems **(Asaad, 2021).**

Currently, 20–40% of all hospital-acquired pneumonia and ventilator-associated pneumonia are caused by MRSA **(Dahal & Schwan, 2018).** The rate of MRSA colonisation in Iran shows 32.8% (95% CI: 26.0-40.4), in Egypt 58.8% Staphylococcus aureus was MRSA, in Ethiopia 44% was MRSA, in China 4.7% of Staphylococcus aureus was MRSA, in Ireland 8.9% and in Europe and the United States the lowest, 1.8% are reported **(Emaneini, Jabalameli, Rahdar, Leeuwen & Beigverdi, 2017).**

In a study done in Egypt, the prevalence of MRSA in HCWs was 14.8% **(Haggag, Aboelnour& Al-Kaffas, 2019).** MRSA prevalence causes a heavy economic burden not only on hospitals but also patients too. The length of a hospital stay for an MRSA infection is roughly twice as long as for any other type of stay—10 days versus 4.6 days, respectively. MRSA infections result in higher morbidity and mortality **(Kilpatrick et al., 2020).**

Colonization of MRSA is commonly in the nose, perineum, and throat**.** The colonization has developed into an MRSA infection as MRSA lead to clinical disease This would involve, for example, skin and soft tissues, bones or joints, intravenous or implanted devices. Treatment of these infection needs expensive and potentially toxic antibiotics **(Prabhoo et al., 2019).**

MRSA can survive in the environment for a very long time and is easily transmitted through a variety of methods. The most significant method for patient MRSA infection in healthcare facilities continues to be the staff-to-patient transmission. MRSA prevalence can be decreased by the use of infection prevention and control (IPC) techniques and restrictions on the use of antibiotics **(Coia et al., 2021).**

Infection prevention and control measure is at the top of the principles of nursing practice, infections prevention requires continuous adherence and compliance with a number of good practices including maintaining of a clean environment, invasive devices

and aseptic techniques management**.** Hospitals, outpatient surgical centers, and other healthcare facilities must effectively prevent and manage infections as a necessity of both patient safety and business viability **(Nguemeleu et al., 2020).**

Nurses need to be aware regarding the essential roles and the consequences of non-adherence to MRSA transmission prevention practices such as hand washing or hand hygiene for infection prevention **(Ahmed, Khalil & Abo Seada, 2021)** so, educational intervention is always needed to enhance nurses' practice regarding MRSA

Significance of the study:

Two studies were conducted in Egypt and revealed that Staphylococcus aureus isolates are the major pathogens responsible for wound and surgical site infections at Minia University Hospital and is consider a potential threat for patients in Egypt **(Ahmed, Gad, Abdalla, Hasaneen & Abdelwahab, 2014)** also**,** transmission of MRSA among patients is linked mainly to health care personnel. 13.5% of HCPs at Hospital in Fayoum had nasal MRSA colonisation **(Hefzy et al., 2016).**

Compliance with infection prevention and control measures has critical implications for HCWs' safety, patient protection, and the care environment **(Alhumaid et al., 2021).** Therefore, educational intervention is needed for health care workers specially nurses to improve adherence and compliance with infection control practices.

Aim of the Study:

The study aimed to evaluate the effectiveness of an educational intervention to improve adherence to Methicillin-Resistant Staphylococcus Aureus control practice among nurses at two hospitals in Egypt

Research hypothesis:

H: Nurses' adherence to Methicillin Resistant Staphylococcus Aureus control practice will improve after the application of the educational intervention.

Subjects and Method

I. Technical Design:

Study design: A pre- and post-test design; prior to and at the completion of the educational intervention.

Setting: This study was conducted at two hospitals in Egypt; Mansoura Chest Disease Hospital and chest depatrement at Benha University Hospital.

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Figure (1) Egypt Map Illustrate The Location of Mansoura and Benha in Egypt

https://www.istockphoto.com/vector/egypt-map-with-flag-gm861872198-142801541

Subjects:

A convenience sample of 80 nurses working at Chest Hospital at Mansoura and chest department at Benha University Hospital.

Tools of data collection:

Tool (I): Nurses' Structured Interview Questionnaire.

This part involved nurses' demographic characteristics as (age, gender, and educational level, hospital name, years of experience, and previous MRSA training courses. Tool was found to be reliable (r = 0.9167).

Tool (II): Observational Checklist for MRSA and Infection Control Practice:

This tool was adapted from **(WHO, 2016)** to evaluate nurses' adherence to MRSA control guidelines. The observation checklist was completed during patient care activities and the participants were not aware of being observed. The observation checklist had infection control practices distributed under different domains namely universal precautions (hand washing, gloving, gowning, goggles, personal hygiene), linens, sharps, and spills precaution. disposal of waste safely, avoiding overcrowding patients, avoiding unnecessary patient transfers between wards, and isolating patients with a known or suspected infection. The reliability was found by Cronbach's Alpha test Kuder-Richardson (KR-20) which evaluates tools' internal consistency and it found to be (r = 0.9485).

Each step that was completed according to the observational checklist for MRSA and infection control practice received a score of one, whereas steps that were skipped or completed incorrectly received a score of zero. The practice score system was put into the following categories: Less than 50% for poor practice, and 50–75% for fair practice while more than 75% considered a good practice **(Mohamed, Ahmed & Tawfik, 2020).**

Pilot Study:

Prior to conducting the study, a pilot study was done on 8 nurses as representatives for 10% of the total sample. Nurses who participated in the pilot study were not included in the study sample. pilot study results were used to examine the proposed methods for statistical and data analysis. Study tools were accomplished without any difficulty, adding support to instrument validity.

Data collection procedure

Once permission was obtained to conduct the study, a schedule for data collecting was established which done over six-months started from July to December 2020. The researcher arrived the hospital from 8.30 a.m. to 1 p.m. The researcher introduced herself to the participants and start to explain the study's aim.

An pre-intervention observation checklist was conducted to determine the nurse's practice. The time needed for completing the checklist ranged from 20 to 30 minutes . based on the pre-intervention observation data and the relevant literature about MRSA and infection control prevention practice, the educational program and session's content were developed. The researcher translated the gap between ideal and actual practice, identified needs, requirements and deficiencies into the educational intervention aim and objectives and then an illustrative colored Arabic booklet was developed and distributed to all participants.

The educational intervention included 8 sessions deived on two main parts theorical and practical part. each session last about 30-45 minutes according to nurses' responses and active participation, as well as the time available and the content of each session.

Session 1:

The main objective of this session was to improve the nurses' knowledge about hospital acquired infection, MRSA infection, methods of transmission of MRSA infection.

Session 2:

The main objective of this session was to discuss how to prevent MRSA and list therapeutic aspects for MRSA infection.

Session 3:

The main objective of this session was to describe and draw six steps in the chain of infection. Compare and contrast methods of preventing infection by breaking the chain of infection.

Session 4:

The main objective of this session was to discuss the factors that place an individual at increased risk for infection, especially health care workers. Describe precautions that must be taken when there is concern about contact, droplet, or airborne disease transmission, linens precautions, and sharps precautions

Session 5:

The main objective of this session was to identify the purpose of hand washing, rubbing and how to demonstrate hand washing and hand rubbing demonstrate donning and removing of gloves.

Session 6:

The main objective of this session was to demonstrate donning and removing of gowning.

Session 7:

The main objective of this session was to demonstrate donning and removing of mask and googles.

Session 8:

The main objective of this session was to demonstrate how to clean spills of blood and other body fluids.

All 80 nurses were divided into 13 groups, 4 to 7 nurses for the group according to nurses's workload. The whole intervention was implemented in 360 minutes(180 minutes) as the theoretical part and the same for the practical component. Each group received 4 sessions in two weeks.

The researcher utilized a variety of approaches of learning in carrying out the program. These included interactive lectures with group discussions, brainstorming to exchange ideas between the participants and the researcher, demonstration and re-demonstration.

Various media were used, including power-point presentations, posters, pictures, illustrated booklet to enhance the process of learning.

After the application of the educational intervention, Each participant was evaluated using the observation questionaire. Comparison between nurses' practice was done before, immediately, and 2 months after the application of the educational intervention to evaluate nurses' ability to apply and adhere to infection control practice to prevent MRSA infection and the degree of effectivenss of health education intervention.

Ethical Considerations:

Consent form was obtained from all study subjects after clarifying that participation in this study was voluntary also, anonymity and confidentiality were assured through coding of all data, and all the information gathered about the nurses' practices was protected and it doesn't affect their annual appraisal.

Statistical Analysis:

After completion of data collection, data were coded, organized, categorized, computerized, and analyzed using the statistical package for social sciences software (SPSS) version 25.0. Armonk, NY: IBM Corp. Descriptive statistics such as frequencies, means, and standard deviations were used to summarize the data. Chi-square and r (correlation) were used to correlate between the studied variables. P values that were less than 0.05 & 0,001 were considered statistically significance and highly significant respectively. The given graphs were constructed using Microsoft Excel software.

Results

Table 1: Frequency Distribution of Nurses Regarding their Demographic Data:

Item	No (80)	Percent
Age		
≤20	3	3.8%
21≥30	34	42.5%
31≥40	42	52.5%
41≥50	1	1.3%
Educational level		
Diplome degree	24	30.0%
Bachelors degree	42	52.5%
Post-graduate degree	14	17.5%
Name of hospital nurse is working in		
Mansoura	54	67.5%
Benha	26	32.5%
Previous attending training course for MRSA prevention		
No	70	87.5%
Yes	10	12.5%

Table (1) illustrates that (52.5%) of nurses were aged between (31-40) years, concerning their educational level, more than half of nurses 52.5% had a Bachelor's degree, 67.5% of participants works at Mansoura hospital while 32.5% works at Benha hospital. 87.5% of nurses had not received previous MRSA training courses.

Figure 2: Frequency Distribution of Nurses Regarding their Gender:

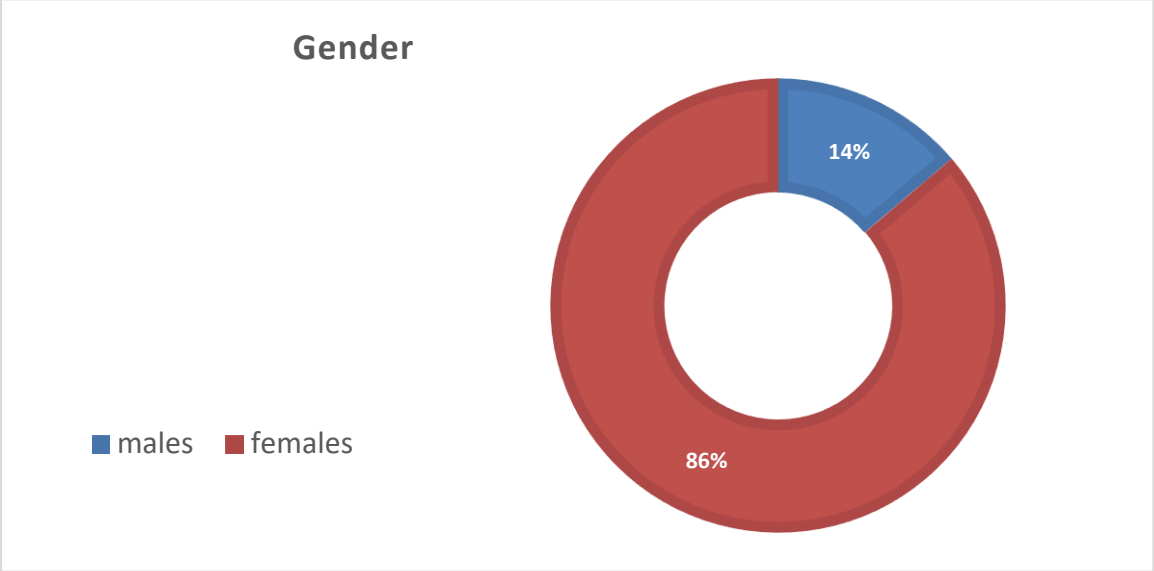


Figure 2 illustrates that the majority of the study sample (86.3%) were females.

Figure 3: Frequency Distribution of Nurses Regarding their Work Experience:

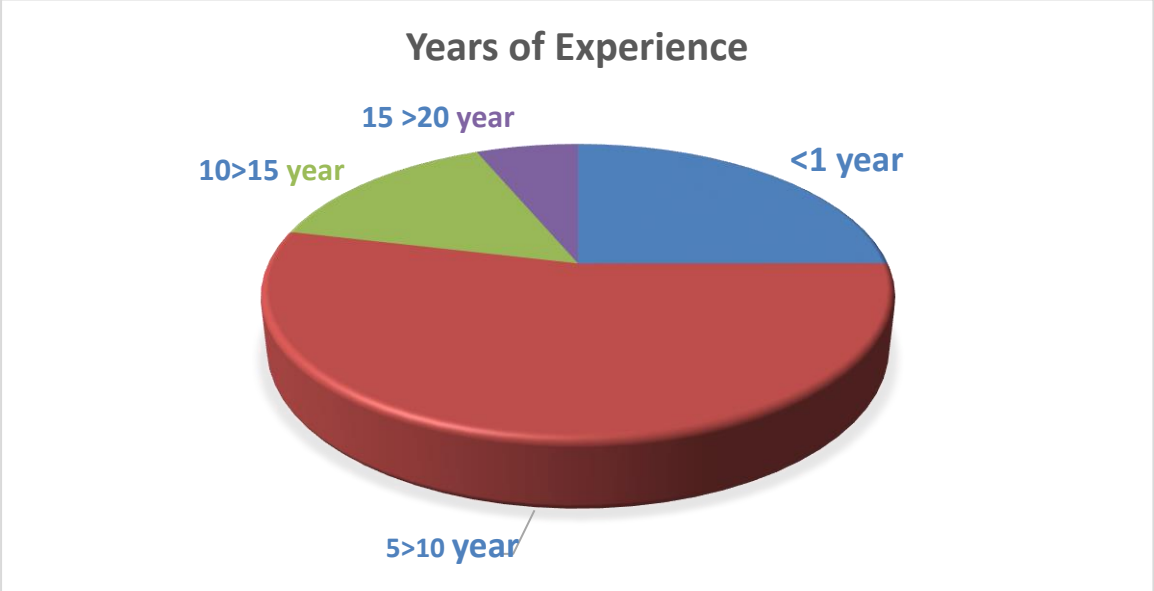


Figure 3 shows that more than half of nurses had from five to ten years of experience.

Table 2: Comparison between the Studied Nurses' Practices Regarding Universal Precautions (Maintain Hand Washing, Disposable Gloves, Aprons, Goggles and Face Shield) (N= 80).

Variables	Pre-Educational intervention				Post Educational intervention				Post-2-months of Educational intervention			
	Done		Not Done		Done		Not Done		Done		Not Done	
	No.	%	No.	%	No.	%	No	%	No	%	No	%
1. Maintain hand washing												
a) Before and after each patient contact	38	47.5	42	52.5	54	67.5	26	32.5	53	69.7	23	30.3
b) After handling blood and body fluids and items contaminated with it.	54	67.5	26	32.5	64	80.0	16	20.0	61	80.3	15	19.7
c) Prior to the aseptic technique.	51	63.8	29	36.3	65	81.3	15	18.8	61	80.3	15	19.7
d) After removing protective clothing/gloves	52	65.0	28	35.0	64	80.0	16	20.0	62	81.6	14	18.4
e) Before handling invasive devices	42	52.6	38	47.5	55	68.8	25	31.3	53	69.7	23	30.3
f) Following bed making	49	61.3	31	38.8	58	72.5	22	27.5	54	71.1	22	28.9
g) Proper drying of hands	27	33.8	53	66.3	45	56.3	35	43.8	43	56.6	33	43.4
Mean ± SD	**3.91 ± 1.255**				**5.06 ± 1.461**				**5.09 ± 1.480**			
2. Use disposable gloves when handling blood and body fluids.	51	63.8	29	36.3	63	78.8	17	21.3	61	80.3	15	19.7
Mean ± SD	**0.64 ± 0.484**				**0.79 ± 0.412**				**0.80 ± 0.401**			
3. Use disposable aprons for direct patient care, bed making, and aseptic techniques.	52	65.0	28	35.0	49	61.3	31	38.8	47	61.8	29	38.2

Mean ± SD	**0.35 ± 0.480**				**0.61 ± 0.490**				**0.62 ± 0.489**			
4. Use goggles and a face shield when applying procedures and contact with a patient with an infection.	40	50.0	40	50.0	51	63.8	29	36.3	47	61.8	29	38.2
Mean ± SD	**0.50 ± 0.503**				**0.64 ± 0.484**				**0.62 ± 0.489**			

It can be seen in table 2 that in the pre-educational intervention period more than half of studied nurses maintained hand washing after handling blood and body fluids and items contaminated with it, prior to the aseptic technique, after removing protective clothing/gloves, before handling invasive devices, and also the following bed making 67.5% 63.8%, 65.0%, 52.6%, 61.3% respectively then the percent elevated to more than 70% immediately after educational intervention

Also, only 33.8 % of nurses dried their hands properly pre-educational intervention and the percentage elevated to 56.3 %, 56.6% immediately and two months post the educational intervention respectively. Furthermore, more than half 56.3% of these nurses applied all the steps of hand washing in the immediate post educational intervention and in the post two-months phase. With highest mean ± SD was found in the post-2-months period (5.09 ± 1.480).

Additionally, it's found that 63.8% of nurses used disposable gloves when handling blood and body fluids in the pre-educational intervention period. 78.8% did it in the immediate-post educational intervention period, and 80.3% in the post-2-months period.. Regarding using disposable aprons for direct patient care, bed making, and aseptic techniques, 65% of nurses did it in the pre-educational intervention period. 61.3% did it in the immediate-post educational intervention period, and 61.8% did it in the post-2-months period. Also, 50% of nurses used goggles and face shields in the pre-educational intervention period. 63.8% used it in the immediate-post educational intervention period, and 61.8% did it during the post-2-months period.

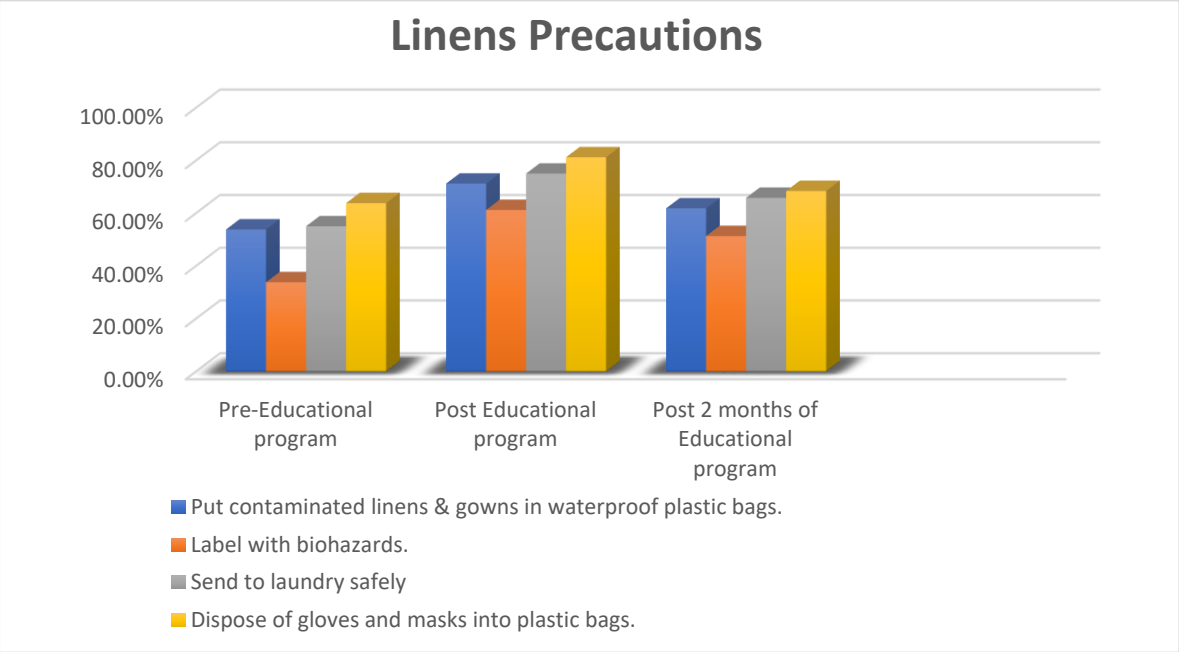
Table 2: Cont. Comparison between the Studied Nurses' Practices Regarding Universal Precautions (Personal Hygiene) (n= 80).

Variables	Pre-Educational intervention				Post Educational intervention				Post-2-months of the Educational intervention			
	Done		Not Done		Done		Not Done		Done		Not Done	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
5. Personal Hygiene												
a) Practice social hand washing appropriate to the situation.	18	22.5	62	72.5	37	46.3	43	53.8	36	47.4	40	52.6
b) Wear unit uniform clean and tidy.	40	50.0	40	50.0	55	68.8	25	31.3	51	67.1	25	32.9
c) Remove jewelry while at work.	41	51.3	39	48.8	52	65.0	28	35.0	48	63.2	28	36.8
d) Keep fingernails short and clean.	64	80.0	16	20.0	67	83.8	13	16.3	63	82.9	13	17.1
e) Change unit uniform when soiled with blood or body fluids.	42	52.5	38	47.5	53	66.3	27	33.8	51	67.1	25	32.9
f) Cover nose and mouth when coughing and sneezing.	39	48.8	41	51.3	54	67.5	26	32.5	53	69.7	23	30.3
g) Avoid exposure to an individual with a communicable disease without standard precaution.	35	43.8	45	56.3	41	51.3	39	48.8	36	47.4	40	52.6
Mean ± SD	**3.49 ± 0.981**				**4.49 ± 1.432**				**4.45 ± 1.455**			

It can be found in table 2 con., that only 22.5% of the studied nurses practiced social hand washing appropriate to the situation at the pre-educational intervention period but in the immediate and two months post educational intervention 46.3%, 47.4% did it respectively. Half 50% of nurses wore unit uniform clean and tidy in the pre-educational intervention period compared with 68.8% in the immediate post and about two third 67.1% in the post-2-months period. Regarding covering nose and mouth when coughing and sneezing, 51.3% of them didn't do it in the pre-educational intervention period, but more than two third 67.5% did it in the immediate-post and the 2 months post educational

intervention. Lastly, 56.3% and 52.6% of nurses didn't a void exposure to an individual with a communicable disease without standard precaution either in the pre-educational intervention or in the post-2-months period respectively, but only 51.3% of them avoided it in the immediate post educational intervention.

Figure 4: Comparison between Participant' Practice Pre, Immediate, and Post 2-months of the Educational Intervention as Regards Linens Precautions



It's found in this figure that 53.8% of nurses put the contaminated linens in the waterproof plastic bags in the pre-educational intervention period, 71.2% in the immediate-post period, and 61.8% put them in the 2 months post-educational intervention. Regarding labeling with biohazards, 66.2% didn't do that pre-educational intervention, but 61.2% and 51.3% did that in both the immediate post and 2 months post-educational intervention.

Additionally, 55%, 75%, and 65.8% of nurses sent the contaminated linens to laundry safely in the three phases respectively. More than 63.8% of the studied nurses disposed gloves and masks into plastic bags in the pre-educational intervention period compared to 81.2%, 68.4 in the immediate post and 2 months post-educational intervention respectively. The highest mean was found in the immediate post educational intervention (2.89 ± 1.031).

Table 3: Comparison between Participant' Practice Pre, Immediate, and Post 2-months of Educational intervention as Regards Sharps Precautions:

6. Sharps Precautions:												
Variables	**Pre-Educational intervention**				**Post Educational intervention**				**Post-2-months of the Educational intervention**			
	Done		**Not Done**		**Done**		**Not Done**		**Done**		**Not Done**	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1.Needles are not recapped by hand.	58	72.5	22	27.5	68	85.0	12	15.0	56	73.7	20	26.3
2.Needles not be bent or broken before disposable.	74	92.5	6	8.5	78	97.5	2	2.5	68	89.5	8	10.5
3.Leave sharps devices carefully in a special container.	58	72.5	22	27.5	63	78.8	17	21.3	52	68.4	24	31.6
Mean ± SD	**2.38 ± 0.718**				**2.61 ± 0.606**				**2.32 ± 0.912**			

Table 3 shows that in the pre-educational intervention 27.5% of nurses recapped the needles by hand compared to 15% in the post educational intervention, and 26.3% in the post 2 months. Also, 8.5% of these nurses bent or broke the needles before disposing in the pre-educational intervention compared to 2.5% in the immediate post and 10.5% in the post 2 months. Additionally, 72.5% of them left sharp devices carefully in a special container compared to 78.8% in the immediate-post educational intervention and 68.4% in the post-2-months period. The highest mean was found in the immediate post educational intervention (2.61 ± 0.606).

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Table 4: Comparison between Participant' Practice Pre, Immediate, and Post 2-months of Educational intervention Concerning Precautions related to Cleaning Spills of Blood and other Body Fluids

Variables	Pre-Educational intervention				Post Educational intervention				Post-2-months of the Educational intervention			
	Done		Not Done		Done		Not Done		Done		Not Done	
	No.	%	No.	%	No	%	No	%	No	%	No	%
7. Precautions related to cleaning spills of blood and other body fluids												
1. Decontaminate surface with O.5% sodium hydrochloride (or suitable disinfection.	55	68.8	25	31.2	69	86.3	11	13.8	58	76.2	18	23.7
2. Clean the surface with soap and water.	34	42.5	46	57.5	53	66.3	27	33.8	46	60.5	30	39.5
3. Rinse with clean water.	47	58.8	33	41.2	59	73.8	21	26.3	53	69.7	23	30.3
4. Dispose of excreta and waste disposal into the toilet.	58	72.5	22	27.5	68	85.0	12	15.0	60	78.9	16	21.1
Mean ± SD	**2.43 ± 0.911**				**3.11 ± 0.811**				**2.86 ± 0.989**			

Table 4 illustrates that 68.8% of nurses decontaminated surface with O.5% sodium hydrochloride in the pre-educational intervention period compared to 86.3% in the immediate-post and 76.2% in the post 2 months. Also, 57.5% of these nurses didn't clean the surface with soap and water, but 66.3% of them cleaned it in the immediate-post and 60.5% did it in the post-2-months period.

Additionally, 58.8% of these nurses rinsed with clean water in the pre-educational intervention period, and 73.8% in the immediate-post and 69.7% in the post-2-months did that. Concerning dispose of excreta and waste disposal into the toilet, 72.5% of them did it in the pre-educational intervention period compared to 85% in the immediate-post and 78.9% in the post-2-months period.

Table 5: Comparison between Participant Nurses' Practice Pre, Immediate, and Post 2-months concerning Dispose of Waste Safely, Avoid Overcrowding Patients, Avoid Unnecessary Patient Transfers between Wards, and Isolate Patients with a Known or Suspected Infection.

Variables	Pre-Educational intervention				Post Educational intervention				Post-2-months of the Educational intervention			
	Done		Not Done		Done		Not Done		Done		Not Done	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
5. Dispose of waste safely.	43	53.8	37	46.2	57	71.3	23	28.8	53	69.7	23	30.3
Mean ± SD	**0.54 ± 0.502**				**0.71 ± 0.455**				**0.70 ± 0.462**			
6. Avoid overcrowding patients	43	53.8	37	46.2	63	78.8	17	21.3	57	75.0	19	25.0
Mean ± SD	**0.54 ± 0.502**				**0.79 ± 0.412**				**0.75 ± 0.436**			
7. Avoid unnecessary patient transfers between wards.	47	58.8	33	41.2	61	76.3	19	23.8	57	75.0	19	25.0
Mean ± SD	**0.59 ± 0.495**				**0.76 ± 0.428**				**0.75 ± 0.436**			
8. Isolating patients with a known or suspected infection.	46	57.5	34	42.5	60	75.0	20	25.0	58	76.3	18	23.7
Mean ± SD	**0.58 ± 0.497**				**0.75 ± 0.436**				**0.76 ± 0.428**			

It's illustrated that 53.8% of nurses disposed wastes safely in the pre-educational intervention period compared to 71.3% in the immediate-post and 69.7% in the 2 months post-educational intervention. Also, 53.8% of nurses avoided overcrowding patients in the pre-educational intervention period compared to 78.8% in the immediate-post and 75.0% in the 2 months post-educational intervention. 58.8% of these nurses avoided the unnecessary patient transfers between wards in the pre-educational intervention period compared to 76.3% in the immediate-post and 75.0% in the 2 months post-educational intervention. Additionally, 57.5% of them isolated patients with a known or suspected infection in the pre-

educational intervention period compared to 75.0% in the immediate-post and 76.3% in the 2 months post-educational intervention.

Table 6: Comparison between Total Nurses Practice Grades Along the Three Periods (N = 80).

Score of Total Practice										P[1]	P[2]	P[3]
Frequency & percentage	**Pre-intervention**			**Immediately post-intervention**			**Post-2-months of intervention**					
	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor	t =	t =	t =
No.	2	52	26	29	45	6	22	43	11	- 8.616	-5.725	3.426
%	2.5	65	32.5	36.3	56.3	7.5	28.9	56.6	14.5	P =	P =	P =
Mean ± SD	**17.99 ± 3.743**			**23.21 ± 3.980**			**22.18 ± 4.465**			0.000**	0.000**	0.001**

P^1 = Pre-intervention and immediately post-educational intervention.

p^2= Pre-intervention and post 2 months of intervention.

p^3= Immediately post- intervention and post 2 months of intervention.

*= Significant differences at $p<0.05$

It is illustrated in table 6 that statistically significant differences were present between all phases of the study regarding nurses' practice, and the highest mean was in the immediate-post intervention phase (23.21 ± 3.980).

Discussion

It is important to note that antibiotic resistance is an ever-worsening issue that creates challenges for practice nurses when caring for patients with infections. Antibiotic-resistant infections are associated with a higher mortality rate than infections caused by the same organism that is not resistant to multiple antibiotics and prolonged hospital lengths of stay impose a considerable burden on health care system networks worldwide **(Fabian, 2019).**

Staphylococcus aureus, especially MRSA), is one of the antibiotic-resistant infections. Approximately 30% of the world's human population is persistent carriers of S. aureus **(Mulcahy & McLoughlin, 2016)**. The carriage rate is even higher in healthcare workers and clinical students **(Lloyd-Price, Abu-Ali & Huttenhower, 2016).**

Moreover, it was evident that the nurse's role is focused on the prevention and control efforts of different infection types. The nursing profession is the major section of healthcare

in the world, they are always on the front lines of providing health care **(Palacios-Ceña et al, 2021).** Therefore, they must demonstrate practices towards achieving the goal of prevention of HAIs, especially MRSA infection. Our study aimed to evaluate the effectiveness of an educational intervention to improve adherence to Methicillin-Resistant Staphylococcus Aureus control practice among nurses at two hospitals in Egypt**.**

Part I: Nurses' Demographic Characteristics

In relation to current study findings of nurses demographic it was noticed that the large number of nurses aged between 31 to 40 years old, and female gender was the dominant in our study, this can be clarified as younger nurses are needed to directly deliver care to the patients as followed by job descriptions and traditional working styles and after years of work and experience, they would be involved more in management duties.

These findings are consistent with previous studies done by **Khalil and Abdel-Fattah Hassan, (2019)** whom reported that the larger number of their participants were in the age group of 31 to 40 years old and the majority of them were female. **Khalifa, and Farghally, (2020)** also reported that female nurses represented the whole percentage of their study sample. On the other hand, study done in Egypt by **Ahmed et al., (2021)** revealed that nearly half of nurses aged between 26 to 29. Also, **Abukhader, and Abukhader, (2020)** stated that the majority of nurses ih their study were male.

In relation to working experience, more than half of nurses have experience of five to ten years and this may be due to increased number of nurses with age between 30 to 40. This finding is in agreement with a study by **(Moqbel, Shebl & Soliman, 2015)** which found that more than half of the nurses had 5-10 years and not in line with **Suss (2017)** study about nurse knowledge, attitude, and compliance related to MRSA and revealed that 86.96% of the studied sample was five years of experience or less.

Concerning nurses' attendance of previous courses related to MRSA prevention, the current findings revealed that the majority of nurses had no previous training courses related to MRSA. This could be due to the shortage of nurses and increase in workload so the number of nurses who had a chance to attend training was few. It is known that the training courses play a significant role in training nurses on how to follow infection control guidelines thus enhancing nurses' practice So, nurses should be provided with recurrent training courses

Our findings are supported by another study conducted by **(Ahmed et al., 2021)** that searched critical care nurses' knowledge regarding Methicillin-Resistant Staphylococcus Aureus at Mansoura University Child Hospital and found that the majority of nurses had no previous training courses**.** On the other side**,** a study by **Suss (2017)** found that more than half of nurses received courses regarding MRSA.

Part II: Nurses Practice Regarding MRSA Prevention Guidelines

A statistically significant difference was found among all phases of the study regarding nurses' practice, and the highest mean was in the immediate post intervention

phase. This could be due to the enrichment of their practice by the educational intervention, and it is noteworthy that the findings of the present study supported the study hypothesis, which indicated that nurses' adherence to Methicillin Resistant Staphylococcus Aureus control practice will be improved after the application of the educational intervention.

A Palestinian study by **Sikora, and Zahra, (2021)** about knowledge, attitudes, and adherence to MRSA transmission prevention among health care workers reported poor adherence concerning performance in all aspects of MRSA infection control precautions among studied subjects. They concluded that education of nurses regarding hand hygiene, cleaning and disinfecting medical equipment, environmental contamination prevention, and isolation precautions should start with staff who are directly in contact with the patients, beginning with nurses, physicians, medical technicians, and environmental service staff.

Our findings are consistent with **Aby, (2015)** who demonstrated that the majority of their nurses had unsatisfactory levels of practice in the pre infection control training program, however, the majority of them in the post program had satisfactory levels and continued in the follow-up had a high level of practice.

Specifically, regarding the standard precautions; concerning hand washing, more than half of nurses applied all the steps of hand washing in the immediately post-educational intervention and the post two months period with the highest mean post-2-months. This could be referred to the knowledge provided about the importance of complete adherence to hand washing practices for their safety and protection from infections. To our knowledge, the **WHO, (2022)** stated that hospital-acquired infections may be transmitted through contaminated hands. Practicing hand hygiene using alcohol-based hand rub or soap and water reduces harmful organisms.

A study by **Zeigheimat et al., (2016)** indicated that a significant difference was found between the scores of both groups after intervention in terms of practice regarding hand washing and safe injection practice. additionally, the systematic review by **Waramlah, and Huda, (2019)** stressed that education alone can enhance standard precautions (SP) knowledge whereas adding education to infection control support could improve practice and compliance slightly. Conversely, education in addition to using checklists, and financial and technical support will probably enhance compliance with SP.

Moreover, the same result was in line with **Khalil and Abdel-Fattah Hassan, (2019)** who revealed that there was an improvement in nurses' knowledge and attitude responses regarding MRSA infection control and prevention after receiving an educational intervention.

The present study states that the appropriate use of PPE increased after implementation of the educational intervention indicating that periodic observation of infection practices of nurses assists them in understanding the compliance level and improving the practices.

This is in line with (**Mello, Latha, Alva & Barnini Banarjee, 2019)** who conducted a cross-sectional descriptive survey and stated that appropriate use of PPE was found in only 43.25% of HCP and highlighted the importance of using educational intervention to improve nurses compliance. The researchers explained this by saying that while these practices are carried out regularly in their units, there are some factors that could limit their effectiveness, such as work overload, a lack of knowledge of the proper steps, or a lack of time to carry out the procedure properly, such as hand washing. So, these findings could give a reflection about the need for nurses to refresh and update their skills.

Our study showed an improvement regarding personal hygiene including social hand washing, wearing the unit uniform clean and tidy and changing it when becoming dirty, removing jewelry while at work, and keeping fingernails short and clean, covering the nose and mouth when coughing and sneezing after application of the intervention.

This is in harmony with **Moqbel et al., (2015)** who found an improvement in compliance with the practice of personal hygiene immediately and 3 months after application of the educational intervention. Additionally an Egyptian study by **Mohamed, Mohamed, and ELmetwaly, (2021)** found statistically significant differences before and immediately after applying their educational intervention and post three months of their intervention regarding all practice items concerning universal precaution.

The present study revealed that the minority of nurses had adequate practice levels prior to intervention implementation as regards handling of soiled linens and this percentage improved to include most of them after the intervention and in follow-up phase. This result is on the same line with (**EL-Shafey, El-Dakhakhny & Mohammed, 2019)** who found that less than half of nurses had an unsatisfactory level of practice related to the handling of soiled linens and practice level improved after the implementation of the educational intervention. Then decreased slightly 2 months after the intervention. This could be reflected to the absence of close supervision, or nurses' neglection, therefore, linens were collected in bags and sent to the laundry.

Regarding precautions related to cleaning blood and other body fluids spills including cleaning the surface with soap and water, rinsing with clean water, disposing of excreta and waste disposal into the toilet, the highest mean (3.11 ± 0.811) was found after the educational intervention and this goes with the result of **Moqbel et al., (2015)** which revealed that the highest mean was found after three months from the educational. This highlight that educational intervention implementation is very effective in enhancing nurses' adherence to infection control practice regarding spills of blood and other body fluids precautions **(Alhumaid et al., 2021).**

Conclusion

There was a statistically significant difference between all phases of the study regarding nurses' practice, and the highest mean was found in the immediate post-intervention phase (23.21 ± 3.980). This means that the educational intervention was

effective in improving adherence to Methicillin-Resistant Staphylococcus Aureus control practice among Nurses at both hospitals.

Recommendations

- Further studies should be conducted to assess the reasons behind the lack of commitment to MRSA control precautions practice and try to find specific causes and solutions for compliance.
- Emphasizing the importance of following the latest updated evidence-based approaches of infection control in continuing education and training programs, and infection prevention with national guidelines (standard precautions) should be provided.
- Enhancing Infection Control Committee tasks to be really implemented.
- Further studies with a larger number of health care providers and different geographical area are needed to confirm these findings.

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