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Nurses' Compliance to Infection Control Precautions: Management of Patient Care Equipment at the Medical and Surgical Departments

Haneya Mohamed El- Banna[1], Nesreen Abdel-Monaem Abou-Zeid[2*], Sharaf Omar Mustafa Shurafi[3]

[1] Professor, Medical Surgical Nursing Department, Faculty of Nursing, Alexandria University, Egypt

[2] Lecturer, Medical Surgical Nursing Department, Faculty of Nursing, Alexandria University, Egypt

[3] Demonstrator, Medical Surgical Nursing Department Faculty of Nursing, Islamic University- Palestine

[2*]E-mail of the corresponding author: Abouzeid.nesreen@gmail.com

Abstract

Introduction: Non-critical of Patient Care Equipment (PCE) in healthcare have been linked to an increased infection risk. All nurses have a role to play in infection control precautions (ICPs) related to management of PCE promoting health. **Aim**: The current study was aimed to determine the nurses' compliance to infection control precautions related to management of patient care equipment at the medical-surgical departments. **Design**: A descriptive research design was used. **Setting**: This study was conducted at the general medical and surgical departments, Alexandria Main University Hospital (AMUH) and Shark El Madinah Hospital. **Sample**: the study constituted a convenient 77 female nurses; 59 from AMUH (hospital A) and 18 from Shark El Madinah Hospital (hospital B). Two tools were developed including: Tool 1: Management of non-critical patient care equipment: Nurses' knowledge regarding infection control precautions (Structured interview schedule). Tool 2: Management of non-critical patient care equipment: Nurses' compliance to infection control precautions (Observational Checklist). **Results**: Most of the nurses i.e. (64.4% and 72.2%) had attended training program(s) about ICPs in hospital A and B respectively. Most of the nurses in hospital A i.e. (88.1%) had satisfactory knowledge as well as in hospital B i.e. (83.3%). The majority (60%) of the nurses who didn't attend training program(s) had poor knowledge and (55.6%) of the nurses had good knowledge. An overall compliance with ICPs related to PCE were detected by (47.01%) of the nurses in hospital A and (79.18%) in B. Nurses' compliance with ICPs related to PCE was not influenced by their age, years of experience, educational level and training programs. **Conclusion**: Nurses' knowledge about ICPs related to management of non-critical PCE was satisfactory among the (Hospital A) nursing staff members, compared to (Hospital B) nurses staff (who demonstrated good knowledge). Compliance with ICPs related to management of non-critical PCE was poor in hospital A than in hospital B. **Recommendations**: Personnel responsible for clean PCE must receive special training on the proper standard procedures. Policies and procedures related to management of PCE have to be developed, updated and continually reviewed to ensure that decontamination processes specified set out by international health agencies

Keywords: Patient care equipment, Nursing compliance, Infection control, Disinfection, Sterilization

1. INTRODUCTION

Healthcare-associated infections (HAIs) are a major challenge for hospitals. Care equipment used on patients/clients can become contaminated with blood, other body fluids, secretions and excretions during the delivery of care. Standard precautions are a set of recommendations designed to help minimizing the risk of exposure to infectious materials such as blood and other body fluids, by both patients and staff, recognizing that anyone can be infected. **Swayze S and Rich S (2011)**

Patient Care Equipment (PCE) is defined as powered equipment intended for use in treatment, diagnosis, monitoring, life sustaining or resuscitating functions. According to **National Health Service (2012)** PCE can be classified to single-use, single-patient use and multi- patient use. It can also be classified according to the infection risk (low, medium or high) and as invasive and non-invasive.

According to **Human Factors Principles for Medical Device Labeling**, decontamination or reprocessing of equipment is an umbrella term used to describe processes that make equipment safe for re-use which includes the destruction or removal of micro-organisms. Inadequate decontamination is frequently associated with outbreaks of infection in hospitals, and all healthcare staff must be aware of the implications of ineffective decontamination and their responsibilities to patients, themselves and their colleagues. Decontamination is a combination of processes – cleaning, disinfection and/or sterilization – that are used to ensure a reusable medical device or patient equipment is safe for further use. Equipment used in healthcare may be designated as single use,

single patient use or reusable multi-patient use. **Medicines and Healthcare products Regulatory Agency (2006)**

Spaulding's classification (1968) believed the nature of disinfection could be understood readily if instruments and items for patient care were categorized as critical, semi critical, and noncritical according to the degree of risk for infection involved in use of the items. Non-critical items are divided into noncritical patient care items and noncritical environmental surfaces. This study will concentrate on non-invasive, reusable communal patient care equipment

According to the Centers for Disease Control and Prevention (CDC), HAIs account for an estimated 1.7 million infections and 99,000 associated deaths each year in American hospitals. A recent study found HAIs to be the sixth leading cause of death in the United States (US), costing the health care industry $6 billion annually, and an average of 8.7% of hospitalized patients developed HAIs, with the highest frequencies of such infections occurring among hospitals in the Eastern Mediterranean and Southeast Asian regions (11.8% and 10%, respectively). Healthcare associated infections (HAIs) remain a major cause of morbidity, mortality and excess healthcare costs. HAIs contribute a considerable cost to the healthcare system, as well as to patients and their families with prolonged hospital stays, readmissions and additional diagnostic tests and treatment. **WHO (2007)**

Medical equipment and surgical instruments are examples of devices that are essential to the care of patients; however, because they typically are designed for reuse, they also can transmit pathogens if any of the steps involved in reprocessing, cleaning, disinfection, or sterilization are inadequate or experience failures. Because the vast majority of pathogens are present in organic matter, e.g. visible soil, the first step in reprocessing, cleaning, is the most important. Any failure to remove soil at this point creates the potential for transmission of infection as the efficacy of subsequent disinfection or sterilization will be compromised. **Infection Prevention and Control Committee (2014)**

Nurses of all branches have a role to play with their specific patient or client groups. Whether nursing in an institution (hospital or nursing home) or in the community (individual homes, health centers or shared housing), nurses must recognize the sources and modes of spread of infectious microorganisms and understand how to apply evidence-based practice to prevent and control infection. This study outlines the requirements for the cleaning of common shared non-critical equipment that will come into contact with patients' intact skin. **Mallik M, Hall C, and Howard D (2009)**

Nurses and other healthcare workers often use medical devices for more than one patient. Nurses have the unique opportunity to reduce the potential for HAIs. The nurse is the member of the healthcare team who leads the rest of the team in practicing prevention strategies to protect the patient and other healthcare personnel from infections. All nurses have a role to play in infection control precautions related to management of PCE promoting health. They assume a wide range of responsibilities to ensure safe and effective infection control precautions encompassing and ensuring patient safety

The increasing number of patients showing up and admitted to Alexandria Main University (AMUH) and Shark El Madinah Hospitals, the decreasing nurse/patient ratios, the absence of clear guidelines related to non-critical PCE, absence of clear policy, the rising morbidity and mortality rates associated with infections, and the subsequent increase in workload demands on nurses side, all these warrant specialized attention to the problem, by health care providers.

No studies have examined the compliance of Egyptian nursing personnel to recommended producers of non-critical PCE. Barriers encountered among those nurses to achieve suggested recent international guidelines or at least acceptable alternatives have to be inquired and declared. These responses and findings will help nurses to avoid future shortcomings in infection control practice and consequently improve the quality of PCE.

1.1Aim of the study: the study aims to determine the nurses' compliance to ICPs related to management of PCE at the medical-surgical departments.

1.2 Operational definition

Patient care equipment refers to equipment that are used for more than one patient and considered non-critical, non-invasive reusable communal equipment including blood pressure cuffs, bedside commodes, carts, trays, drip stands, infusion pumps, lockers, stethoscopes, trolleys, wheelchairs, Electrocardiograph (ECG) equipment, beds, mattresses, pillows, oxygen masks, sputum containers (kidney basin), linens, bedpans, thermometers, urinals, and toilet seats.

2. MATERIALS AND METHOD

2.1 Materials

2.1.1 Design: A descriptive research design was used to collect data in the present study.

2.1.2 Setting: This study was conducted at the general medical and surgical departments, Alexandria Main University Hospital (AMUH) and Shark El Madinah Hospital.

2.1.3 Subjects: Sample of the study was constituted a convenient 77 female nurses; 59 from AMUH (hospital A) and 18 from Shark El Madinah Hospital (hospital B).

2.1.3 Tools: Two tools were developed for data collection including:

Tool 1: Management of non-critical patient care equipment: Nurses' knowledge regarding infection control precautions (Structured interview schedule). This tool comprised a structured interview developed by the researchers after review of related literatures **National Health Service (2012)**, **Damani, N. (2004)**. This tool aimed to assess the nurses' knowledge related to infection control precautions (ICPs) regarding management of patient care equipment (PCE), it consisted of two parts:

Part one: This part included nurses' characteristics (part 1-A) namely; department, unit, age, gender, level of education, years of experience. The previous infection control courses attended and hospital policy were assessed using (part 1-B).

Part two: This part aimed to assess the nurses' knowledge related to ICPs regarding management of PCE. It consisted of two main subcategories as follows:

- General knowledge about ICPs related to management of PCE. It included (13) multiple choice and (5) open ended questions. Each correct answer in the multiple choice questions was given a score of three (3) and incorrect answer a score of zero (0). Each correct answer in open ended questions was given a score of three (3), somewhat correct answer a score of two (2), incorrect answer a score of one (1) and no answer a score of zero (0).
- Nurses' knowledge about cleaning methods related to management of PCE. This subcategory included (16) true and false questions about cleaning of noncritical, non-invasive reusable communal PCE. Each correct answer was given a score of three (3) and incorrect answer a score of zero (0).

Tool 2: Management of non-critical patient care equipment: Nurses' compliance to infection control precautions (Observational Checklist). This concealed observational checklist was developed by the researchers after review of related literatures **Damani, N. (2004), PIDAC (2012).** It used to determine nurses' compliance with infection control guidelines throughout their care of non-critical, non-invasive reusable communal PCE. The total numbers of items observed were (19) main items. Each item checked in terms of "compliance", was given a score of one (1) and "non-compliance" a score of zero (0).

A Total subject's and an overall subjects' score as well as the watched nurses' compliance, were estimated as follows: more than 75% represented a "good" knowledge, or compliance, from 50% to less than 75% represented a "satisfactory" knowledge, or compliance, and less than 50% will represented a "poor" knowledge, or compliance.

2.2 Method

2.2.1 Official permissions

- Approval from the ethical committee of Faculty of Nursing, Alexandria University was obtained.
- Permission to carry out the study was taken from the responsible authorities after explanation of the aim of the study.

2.2.2 Tool development

- Tools of the study were developed by the researchers based on the relevant literatures.
- These tools were tested for content and construct validity by 11 experts in medical surgical nursing teaching staff, heads of infection control committees of the affiliated hospitals, as well as charge nurses at the specified hospitals units. Comments and suggestions were reviewed and necessary changes were done accordingly;
  - Some open ended questions were changed to closed ended questions in tool I, based on experts suggestions.
  - Marital status from socio demographic data was excluded.
  - (Not applicable) "NA" column was added to tool II.

- The developed tool I was translated into Arabic language. - Reliability of the tools was tested by using Alpha Cronbach's test. The Cronbach's coefficient alpha score for nurses' knowledge (Tool I) was 0.683 and for observational checklist (Tool II) was 0.943.
- A pilot study was conducted on (7) nurses after explanation of the aim of the study and taking oral consent at the general medical and surgical units, in order to test the clarity and applicability of the tools. Necessary modifications were done prior to data collection for the actual study; those nurses were excluded from the study sample.

2.2.3 Data collection

- Nurses were interviewed once to answer the structured interview schedule (Tool I) individually, after explaining the purpose of the study and obtaining their oral consent for participation in the study. The interview was carried out during the break hours and the answers were recorded immediately. The time of interview ranged from 30-45 minutes, each.
- Every nurse working in the previously mentioned units, throughout management of the identified PCE was observed 3 times, twice at the morning and once at the afternoon shifts, using observational checklist items (Tool II).
- The overall study data collection period lasted for a total of two months starting from beginning of April 2015 till the end of May 2015.

2.2.4 Ethical considerations

An oral consent was obtained from the participants. Privacy and confidentiality of responses were assured. The anonymity and the right to refuse or withdraw from the study were emphasized to the study sample.

2.2.5 Statistical analysis

The data were analyzed using SPSS program version 20. The collected data categorized, coded, computerized, tabulated and analyzed. The following statistical measures were used: Qualitative data were described using number and percent. Quantitative data were described using mean and standard deviation. Number and percentage (No %) were used for describing and summarizing qualitative data. Chi-square test (X2) was used for comparison between the distributions of two qualitative variables. Mont Carlo and Fisher Exact tests were used for comparison between the distributions of two qualitative variables whenever the (X2) test was not appropriate. T-test was used for comparison between qualitative data in the same group. The level of significance selected for this study was p equal to or less than 0.05. Association (or relationship) between the categories of two independent variables reflects a real association between two variables in the population.

3. RESULTS

Table (1) shows the frequency distribution of the study subjects according to their socio-demographic characteristics.The results show that a group of 77 female nurses was enrolled in this study. The highest percentage was among age group (30- >40) years. It was distributed as (32.2%) and (55.6%) for hospital A and hospital B, respectively. The majority (79.8%) of the nurses were diploma holders in hospital A, and (77.8%) in hospital B. Moreover, (52.5% and 50%) of the nurses were working at the general surgical units, while (47.5% and 50%) of them were working in the general medical units in these hospitals, respectively. Most nurses (49.2%) had more than 20 years' experience in hospital A, and many (33.3%) of the nurses' experience were from 10 to less than 15 years in hospital B.

Figure 1, 2 exhibits that most (64.4% and 72.2%) of the nurses had attended training program(s) about infection control related to management of PCE in hospital A and B respectively. On the other hand, it was found that (67.8% and 100%) of the nurses reported that they had a clear written policy in hospital A and B respectively.

Table (2): show overall score of nurses' knowledge about ICPs related to management of non-critical PCE. This table reveals that the majority (89.8%) of the nurses in hospital A had poor knowledge (low than 50%) in part I, while (66.7%) of the nurses in hospital B had satisfactory knowledge (between 50% to less than 75%). Many nurses (54.2% and 61.1) in these hospitals had satisfactory knowledge. Furthermore, in overall knowledge the highest percentages had satisfactory knowledge in hospital A and good knowledge in hospital B, distributed as (88.1% and 83.3%) for hospital A and B respectively. The differences between the two hospitals were statistically significant ($p = 0.001$) indicating satisfactory knowledge in hospital A and good knowledge in hospital B.

Table (1) shows the frequency distribution of the study subjects according to their socio-demographic characteristics

Socio-demographic data	Hospital			
	Alexandria Main university (Hospital A) (n =59)		Shark El Madinah (Hospital B) (n = 18)	
	No.	%	No.	%
Gender				
Male	0	0.0	0	0.0
Female	59	100.0	18	100.0
Age (years)				
20≤30	17	28.8	6	33.3
30≤40	19	32.2	10	55.6
40≤50	15	25.4	2	11.1
≥50	8	13.6	0	0.0
Educational Level				
Diploma*	47	**79.7**	14	**77.8**
Technical**	9	15.3	2	11.1
Bachelor of Science in Nursing	3	5.1	2	11.1
Experience (years)				
<5	6	10.2	3	16.7
5≤10	6	10.2	2	11.1
10≤15	10	16.9	6	**33.3**
15≤20	8	13.6	3	16.7
>20	29	**49.2**	4	22.2
Department				
Surgical	31	52.5	9	50.0
Medical	28	47.5	9	50.0

* Three years after preparatory school ** Five years after preparatory school or two years after secondary school

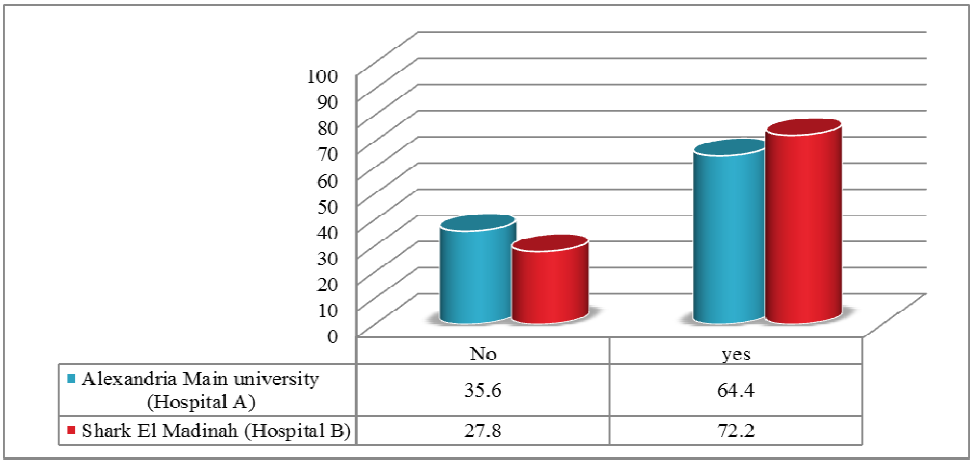

Figure 1: Distribution of nurses according to attendance of training program(s).

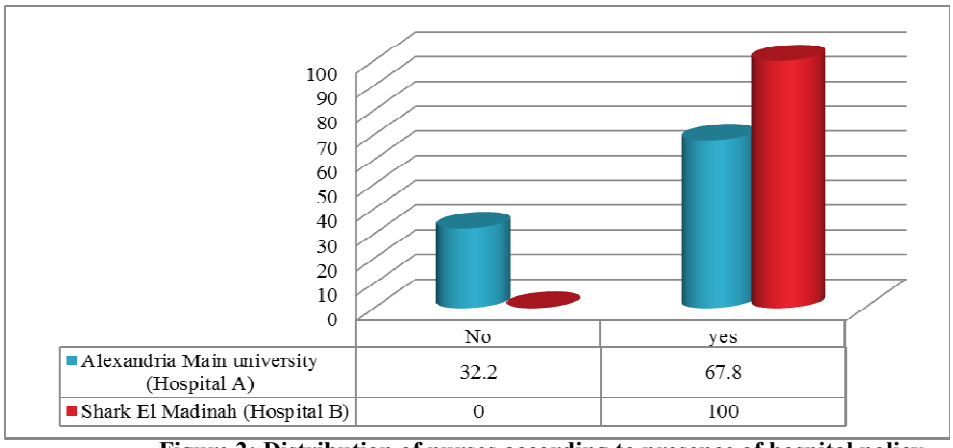

Figure 2: Distribution of nurses according to presence of hospital policy

Table (2): Overall score of nurses' knowledge about ICPs related to management of non-critical PCE.

Overall score of nurses' knowledge	Hospital				χ^2	^{MC}p
	Hospital A (n = 59)		Hospital B (n = 18)			
	No.	%	No.	%		
Part I						
<50% (poor)	53	**89.8**	6	33.3	24.578	0.001*
50% - <75% (satisfactory)	6	10.2	12	**66.7**		
≥75% (good)	0	0.0	0	0.0		
Part II						
<50% (poor)	14	23.7	0	0.0	6.521	0.038*
50% - <75% (satisfactory)	32	**54.2**	11	**61.1**		
≥75% (good)	13	22.0	7	38.9		
Overall Knowledge						
<50% (poor)	0	0.0	0	0.0	19.466	0.001*
50% - <75% (satisfactory)	52	**88.1**	3	16.7		
≥75% (good)	7	11.9	15	**83.3**		

χ^2: Chi square test, MC: Monte Carlo test, *: Statistically significant at $p \leq 0.05$

Table (3): reveals relationship between total score of nurses' knowledge about ICPs related to management of non-critical PCE and socio-demographic data at the studied hospitals. This table indicates that there is a significant association (p=0.025) between the subject' age and their knowledge about ICPs related to management of PCE. Many nurses (40%) in the age group 20 years to less than 30 years had poor knowledge, while (43.8%) of the nurses in the age group 30 years old to less than 40 years had satisfactory knowledge and (66.7%) of the nurses at the same age had good knowledge. In addition, most of the nurses were diploma graduates, so there is no significant association between educational level and knowledge. Experience years of the nurses had also a significant association (p=0.006) with their knowledge, where (55%) of the nurses having more than 20 years of experience had poor knowledge (45.8%) of the nurses with the same experience had satisfactory knowledge, and (55.6%) of nurses having experience of 15 years to less than 20 years had good knowledge.

Table (3): Relationship between total score of nurses' knowledge about ICPs related to management of non-critical PCE and socio-demographic data at the studied hospitals.

Socio-demographic data	Knowledge						χ^2	P
	<50 Poor (n = 20)		50-<75 Satisfactory (n = 48)		≥75Good (n = 9)			
	No.	%	No.	%	No.	%		
Age (years)								
20<30	8	**40.0**	12	25.0	3	33.3	13.239	$^{MC}p= 0.025^{*}$
30<40	2	10.0	21	**43.8**	6	**66.7**		
40<50	6	30.0	11	22.9	0	0.0		
>50	4	20.0	4	8.3	0	0.0		
Educational Level								
Diploma*	19	**95.0**	33	**68.8**	9	**100.0**	6.660	$^{MC}p=0.099$
Technical**	1	5.0	10	20.8	0	0.0		
Bachelor of Science in Nursing	0	0.0	5	10.4	0	0.0		
Experience (years)								
<5	2	10.0	6	12.5	1	11.1	17.956	$^{MC}p=0.006^{*}$
5≤10	3	15.0	3	6.3	2	22.2		
10≤15	3	15.0	12	25.0	1	11.1		
15≤20	1	5.0	5	10.4	5	**55.6**		
>20	11	**55.0**	22	**45.8**	0	0.0		

χ^2: Chi square test, MC: Monte Carlo test,*: Statistically significant at $p \leq 0.05$* Three years after preparatory school ** Five years after preparatory school or two years after secondary school

Table (4): presents the relationship between total score of nurses' knowledge about ICPs and their attendance of training program(s) about infection control and presence of hospital policy at the studied hospitals. This table shows that the attendance of relevant training program(s) had a significant association **(p=0.002)** with nurses' knowledge, where the majority (60%) of the nurses who didn't attend training program(s) had poor knowledge. On the other hand (81.3%) of the nurses who attended training programs had satisfactory knowledge and (44.4%) of the nurses had good knowledge. Also a clear written policy had a significant association **(p=0.002)** with their knowledge, where (50%) of the nurses who told they haven't a clear written policy had poor knowledge, while (81.3%) of them who told they have a clear written policy had satisfactory knowledge and (100%) of the nurses had good knowledge.

Table (5): shows Overall score of nurses' compliance with ICPs related to management of PCE. This table illustrates that there is a significant difference (p=0.001) between the two hospitals in overall compliance to ICPs, where the majority (89.8%) of the nurses in hospital A were non-compliant with ICPs. In contrast, in hospital B (88.9%) of the nurses was compliant.

Table (4): Relationship between total score of nurses' knowledge about ICPs and their attendance of training programs about infection control and presence of hospital policy at the studied hospitals

Training program(s) and hospital policy	Knowledge						χ^2	P
	<50 Poor (n = 20)		50-<75 Satisfactory (n = 48)		≥75Good (n = 9)			
	No.	%	No.	%	No.	%		
Infection control courses:								
No	12	**60.0**	9	18.8	5	**55.6**	12.905	^{MC}p= 0.002*
yes	8	40.0	39	**81.3**	4	**44.4**		
Clear written policy from the hospital about dealing with non-critical patient care equipment.							9.773	^{MC}p= 0.006*
No	10	**50.0**	9	18.8	0	0.0		
yes	10	50.0	39	**81.3**	9	**100.0**		

χ^2: Chi square test, MC: Monte Carlo test, *: Statistically significant at $p \leq 0.05$

Table (5): Overall score of nurses' compliance with ICPs related to management of PCE.

Overall score of nurses' compliance	Hospital				χ^2	p
	Hospital A (n = 59)		Hospital B (n = 18)			
	No.	%	No.	%		
Overall practice						
<60% (non-compliance)	53	**89.8**	2	11.1	51.877	0.001*
≥60% (compliance)	6	10.2	16	**88.9**		

χ^2: Chi square test, *: Statistically significant at $p \leq 0.05$

Table (6): presents the relationship between nurses' compliance with ICPs related to management of non-critical PCE and their attendance of training program(s) about infection control and presence of hospital policy. This table shows that the attendance of relevant training program(s) had no relations to nurses' compliance. In contrast a clear written policy had a significant relation **(p=0.095)** with nurses' compliance, since most of the nurses who told yes were compliant.

Table (6): Relationship between nurse's compliance with ICPs related to management of non-critical PCE and their attendance of training programs about infection control and presence of hospital policy

Training pregame(s) and heath policy	Total score of compliance with ICP				χ^2	p
	<60% (non -compliance) (n = 53)		≥60% (compliance) (n = 24)			
	No.	%	No.	%		
Infection control courses:						
No	18	34.0	8	33.3	0.003	0.957
yes	35	66.0	16	66.7		
Clear written policy from the hospital about dealing with non-critical patient care equipment.					2.781	0.095*
No	16	30.2	3	12.5		
yes	37	69.8	21	**87.5**		

χ^2: Chi square test MC: Monte Carlo test *: Statistically significant at $p \leq 0.05$

Table (7): presents the relationship between nurse's compliance with ICPs related to management of non-critical PCE and socio-demographic data at the studied hospitals. This table shows that subjects' age, educational level and years of experience had no associated to their compliance with ICPs as (p = 0.365, 0.905 and 0.342),

respectively

Table (7): Relationship between nurse's compliance with ICPs related to management of non-critical PCE and socio-demographic data at the studied hospitals.

Socio-demographic data	Total score of compliance with ICP				χ^2	P
	<60% (non- compliance) (n = 53)		≥60% (compliance) (n = 24)			
	No.	%	No.	%		
Age (years)						
20 - <30	16	30.2	7	29.2		
30 - <40	17	32.1	12	**50.0**	3.177	0.365
40 - <50	13	24.5	4	16.7		
> 50	7	13.2	1	4.2		
Department						
Surgical	25	47.2	24	100.0	19.925	0.001*
Medical	28	52.8	0	0.0		
Educational Level						
Diploma	42	79.2	19	79.2	0.455	0.905
Technical	8	15.1	3	12.5		
Bachelor of Science in Nursing	3	5.7	2	8.3		
Experience (years)						
<5	6	11.3	3	12.5		
5- <10	6	11.3	2	8.3	4.519	0.342
10- <15	8	15.1	8	**33.3**		
15- <20 years	7	13.2	4	16.7		
>20	26	**49.1**	7	29.2		

χ^2: Chi square test, MC: Monte Carlo test,*: Statistically significant at p ≤ 0.05* Three years after preparatory school ** Five years after preparatory school or two years after secondary school

4. DISCUSSION

Infection is one of the greatest patient safety concerns associated with reuse. The risk of cross-infection may increase due to the inability of the reprocessing system to completely remove viable micro-organisms. There is a system in place that ensures as far as reasonably practicable that all re-usable patient care equipment (PCE) are properly decontaminated prior to use and that the risks associated with decontamination facilities and processes are adequately managed **Medicines and Healthcare Products Regulatory Agency (2013)**

The decontamination of re-usable medical devices is the combination of processes, which if not correctly undertaken, individually or collectively, may increase the likelihood of infectious agents being transferred to individuals, or the environment. The re-usable medical device life cycle comprises cleaning, disinfection, inspection, disposal, packaging, transportation, and storage before use. This cycle is used to render a re-usable item safe for further use. **Controls Assurance Standard (2013)**

In relation to gender, the findings of the current study showed that, all of the study subjects were females**.** This was in line with **Yassi *et al* (2007)** , and **Fernanda *et al* (2015)** who reported that most of nurses were females. Most of nurses in various countries are females by the nature of their job. In the current study, **subjects' age** revealed that the majority of nurses were in the age group of (30- >40) years in Alexandria Main university hospital (Hospital A) and Shark El Madinah hospital (Hospital B). This finding was nearly similar to the finding of **Ganczak, Szych (2007)** and **Stein *et al* (2003)** who studied the doctors' and nurses' knowledge, attitudes and compliance with infection control guidelines in Birmingham teaching hospitals. They reported that the highest percentage of the nurses were in the same age group.

Concerning the educational level, the present study showed that the majority of the nurses were diploma holders in the two hospitals. This was in line with **Yassi *et al* (2007)** who reported that the most respondents were diploma graduates. This finding contradicts with **Omar (2104)** who studied infection control practices among intensive care unit registered nurses in Jordan. He reported that the majority of the nurses held a bachelor's

degree. Also, the present study showed that most nurses had more than 20 years' experience. This finding contradicts with **Sodhi *et al* (2013)** who reported that the highest percentage of nurses' experience was between 0-5 years.

The current study showed that more than half of the nurses had attended training program(s) about infection control related to management of PCE at the two hospitals. Moreover most of nurses reported that they had a clear written policy about infection control precautions (ICPs) in the two hospitals. Attending continuing nursing education courses and training programs have the benefits of keeping nurses up-to-date and refining their practices especially in carrying out procedures that require strict aseptic techniques.

In relation to knowledge about ICPs related to management of non-critical PCE, assessment of the nurses' knowledge in this study revealed that the majority of the nurses had incorrect answers in hospital A, contrary in hospital B nurses' answers. However, hospital A nurses had better knowledge about the cleaning methods. On the other hand, more than two thirds of the studied nurses in hospital A had satisfactory knowledge, compared to hospital B staff good knowledge. The differences between the two hospitals were statistically significant indicating satisfactory knowledge in hospital A and good knowledge in hospital B. **In general** nurses' knowledge about ICPs related to management of non-critical PCE were considered acceptable. This was in agreement with **Hefzy *et al* (2005)** and **Vaz *et al* (2010)** who found that the nurses in these studies had good knowledge and compliance scores by more than 50% of participants.

Nurses' knowledge about ICPs related to management of non-critical PCE were influenced by the subjects' age, experience years, attendance of relevant training program(s), and presence of clear written policy. The present study indicates that there is a significant association between the above mentioned variables and staff knowledge. It revealed that most of the nurses in the age group 30 years old to less than 40 years had satisfactory and good knowledge.

Concerning assessment of nurses' compliance about ICPs related to management of non-critical PCE, the current study demonstrated that, more than half of the studied sample had poor in hospital A were complying poorly, while many demonstrated good compliance in hospital B. There was poor compliance with principles of environmental control in hospital A, especially in "maintaining the working environment in a hygienic state at all times" and "cleaning of environmental surfaces by using separate buckets", and vice versa in hospital B. These results could be related to limited number of hospital cleaners and extra duties in hospital A. Examples of these responsibilities include transferring patients to other units, in environmental hygiene. Private companies for cleaning and disinfection can be of help in this regard.

The present study showed that there were significant differences among the units in compliance with non-critical PCE management. For example, it was noticed that head &neck and colorectal surgeries units' staff demonstrated more compliance than other units; which could be due to frequent follow up from personnel in charge of these units. Also, it was noticed that the chest unit had less poor compliance than others units. This may be attributed to the increased number of the beds, increased space of unit, less nurses, and hospital cleaners.

It was revealed that, nurses' compliance with ICPs related to PCE was not influenced by their age, years of experience, educational level and training programs. This could indicate that compliance depends on individual differences, presence of supervision and presence of incentives. This finding contradicts with **Omar (2104)** who reported that nurses who received infection control education reported greater compliance with infection control practices in Jordan, and **Kandel (2014)** who reported that compliance was positively correlated with nurses' level of education in Egypt. In contrast the results showed that the presence of a clear hospital policy had a significant relation with nurses' compliance, it seems that there was no written policy in hospital A as in hospital B.

The relationship between nurses' compliance with ICPs and their knowledge, the findings in the current study revealed that there was a significant association between nurses' knowledge and compliance with ICPs related to PCE. Nurses with good knowledge complied well and vice versa. This finding was in accordance with **Taneja *et al* (2009)** who had evaluated knowledge and practice of nursing staff toward infection control measures in a tertiary care hospital in India, and **Abed-El Hafiz (2007)** who reported that there was a significant positive correlation between nurses' knowledge and their compliance with ICPs in Egypt. They all, had reported a positive association between their participants' knowledge and compliance with ICPs. Such findings are expected because lack of knowledge will automatically lead to lack of compliance. How could anyone comply with what he/she does not know?

It was clear that nurses at the two hospitals received compulsory infection control training and updates, but the implementation of ICPs were insufficient and selective. Interestingly, Shark El Madinah Hospital nurses

performed significantly better than Alexandria Main University hospital nurses in terms of overall ICPs compliance related to management of PCE.

5. CONCLUSION

Based on the findings of the present study, it could be concluded that: Nurses' knowledge about infection control precautions (ICPs) related to management of non-critical patient care equipment (PCE) was satisfactory among the Main University Hospital (Hospital A) nursing staff members, compared to Shark El Madinah Hospital (Hospital B) nurses who demonstrated good knowledge. Compliance with ICPs related to management of non-critical PCE was poor in hospital A and good in hospital B. Poor compliance in A. The relationship between nurses' compliance with ICPs and their knowledge, there was a significant association between nurses' knowledge of and compliance with ICPs related to PCE. Nurses with good knowledge complied well and vice versa.

6. RECOMMENDATIONS

Based on the findings of the present study, the following recommendations are suggested and forwarded: Personnel responsible for clean PCE must receive special training on the performance of standard procedures. Written cleaning instructions should be available for each piece of equipment. Policies and procedures related to management of PCE have to be updated and continually reviewed. Rigorous research design is needed to discover the actual effect of decontamination system intervention on healthcare-associated infection risks. Finally, development of standards about ICPs related to management of PCE.

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