

Hand Hygiene Knowledge, Attitude and Barriers among Jordanian Nurses

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Abstract – Hand hygiene is the most effective recommended practice to prevent hospital-associated infections. Although, hand hygiene compliance rate is still low. The general purpose of this study was to describe Jordanian nurses' knowledge, attitudes, and barriers toward hand hygiene. A non-experimental descriptive cross-sectional design was used for this study. Validated self-reported questionnaires were used among 207 nurses (106 male and 101 females) from four major hospitals in Jordan. Nurses have a moderate level of knowledge (13.83 ± 2.64) and moderate positive attitudes (32.74 ± 4.54). Furthermore, nurses who were working in private hospitals had higher levels of knowledge than nurses who work in teaching hospitals who had higher levels of knowledge than nurses working in governmental hospitals. Nurses who were working in private hospitals had higher levels of attitude than nurses working in teaching and governmental hospitals. Surgical nurses had higher levels of an attitude than ICU nurses and higher levels than medical nurses. On the other hand, ER nurses had shown the lowest attitude. In addition, the result showed that the most important barriers toward hand hygiene were: 1) insufficient time, 2) skin irritation, 3) wearing gloves, 4) lack of knowledge, and 5) ignorance of guidelines. In conclusion, there is a need for continuous education about hand hygiene in order to improve hand hygiene knowledge and to enhance the change in attitude. This study revealed that some of the major barriers were workload, skin irritation and wearing gloves. Management should reduce workload and provide appropriate hand hygiene products.

Keywords: Hand hygiene, knowledge, attitude, and barriers.

1. Introduction

In 2011, nearly 722.000 patients acquired infection during their stay in US health care setting [22]. Data of The Centers for Disease Control and Prevention (CDC) showed that around 75,000 patients died during their staying in hospital from 648.000 patients who suffer from Health-Care Associated Infection (HAI) in 2014 [22]. Health-Care Associated Infection is an infection that patients acquired during their stay at the hospital, which was not present before, could be restrained, and affects health and life of the patients [10].

The numbers of HAI in US in 2011 was as the following: a) pneumonia 157.500, b) gastrointestinal 123.000, c) Urinary Tract Infections 93,300, d) primary blood stream infections 71.900, and e) surgical site infection for all surgeries types 157.500 [22]. According to annual report of European CDC more than four million people in Europe acquire HAI infection every year, and nearly 73.000 die as a direct result of this infection [1]. The situation is approximately the same in developing countries, or even worse. For instance, a Lebanese study over a 4 years period showed that device-related healthcare-associated infections (D-HAI) rates ranging from 22-60%. Moreover, the mortality from these infections reached up to 60 % [15].

There are different effects of HAI, some of which might have serious impact on quality of life and might be one reason for death [10]. In addition, the financial impact of HAI is not less important because there is an increase in cost of treatment as a result of longer length of stay during hospitalization [28]. Furthermore, extra costs are deemed as a result of further laboratory, diagnostic studies and medication use [10]. It has been

estimated that the annual direct cost of increased length of stay for patient who acquired HAI was nearly 7 billion in Europe and 6.5 billion in US. [1, 28, 5]

The reduction of HAI by following prevention programs lead to significant decrease in cost, improvement of patient satisfaction, quality of life and better use of the resources [5]. One of the most important programs in infection control practices is to prevent cross infection of pathogen transmitted from health-care workers to patient and from patient to another [13]. This program practices include: a) hand hygiene, b) environmental cleaning, and c) isolation precaution. These practices have been shown to decrease HAI, improve patients' safety, and reduce the cost of health care [13].

Hand hygiene is the easiest and the most efficient practice to prevent HAI because it has been shown that the hands of the health care providers are the major way of microorganisms' transmission during health care [31]. Nurses consist the largest portion of any health care sector [16]. Therefore, nurses should know hand hygiene products and differentiate between them. In addition, nurses should know how, when and where hand hygiene must be performed. Furthermore, positive attitude toward hand hygiene plays a remarkable role [16].

Even though that the hand hygiene is simple and does not require time and effort, there are different factors affecting its usefulness. One of the most important factors is the compliance to perform hand hygiene [6]. There are different reasons behind poor hand hygiene compliance. These reasons are usually termed/reported by health care providers as barriers [6,30].

The barriers are classified into two major types. The first type is: barriers related to setting conditions (i.e. lack of sink or product empty dispensers, workload and limited time to do complete hand hygiene process as recommended) [6,30]. The second type is personal barrier (i.e. negative attitudes, lack of knowledge about hand hygiene and skin irritation due to reptilian of hand hygiene mistaken thoughts. lack of role model) [6,30].

Almost all developed countries suffer from poor hand hygiene compliance due to different barriers; [17]. Taking this point into consideration, no wonder that these barriers will be present in developing countries which led to poor hand hygiene compliance also. Determining the levels of knowledge and attitudes that nurse have will help nursing administrators to identify the needs for those nurses. Furthermore, identifying the most important barriers toward hand hygiene is an essential basic step to implement programs solving the issue of poor compliance.

Improving hand hygiene compliance will reduce HAI leading to better patients' satisfaction with nursing care, decrease complications, length of stay and enhance proper use of institutional resources. Therefore, the general purpose of this study was to describe Jordanian nurses' knowledge, attitudes and barriers toward hand hygiene. *Research questions:* 1) what is the Jordanian nurses' Knowledge level about hand hygiene? 2) do Jordanian nurses have a positive attitude toward hand hygiene? 3) is there any difference in knowledge /attitude levels based on selected sociodemographic (gender, hospital type, and working area)? 4) is there an association between knowledge /attitude and age or years of experience? and 5) what are the most important barriers toward hand hygiene among Jordanian nurses?

2. Methods

2.1 Research Design, sample and setting:

A non-experimental, descriptive, cross-sectional design was used to meet the objectives. Data were collected from all departments of (one government, two privates, and one teaching) hospitals in Amman, Jordan. A

convenience sample of target population who meet the following inclusion criteria was included in the study: a) registered nurse with more than 3 months experiences, and b) Jordanian nationality.

A sample size of 180 participants was enough to achieve 80% power with an alpha of 0.05, and a medium effect size (0.25). This number was obtained based on Cohen power tables with the following statistical tests to answer research questions. Descriptive statistics ($M \pm SD$, or frequencies and percentages) for questions number one, two, and five. T-test or Analysis of variance (ANOVA) with post hoc test for questions number three with four groups as grouping variable. Bivariate correlation was used to answer question number four. Based on that, the maximum number of participants needed was 180.

2.2 Ethical consideration

The study was approved by the research and ethical committee at the Applied Science Private University. IRB approval was obtained from Ministry of Health, and permissions to collect data were also obtained from the private hospitals before data collection. Participation in the study was voluntary and all protective measures were taken to ensure confidentiality and anonymity of participants. Participants were informed regarding the purpose of the study and signed the cover sheet prior to data collection to ensure voluntary participation. If the participant signed the cover sheet and returned the questionnaire back, this was considered as an informed consent. All collected data were coded and entered to a password protected computer with an access only to the principle investigator and the co-investigator. Only aggregate data were used for publication purposes.

2.3 Data collection Procedure

After getting the IRB approvals, the principle investigator explained the purpose of the study to hospital managers and nursing directors and got a permission to start data collection at the sites. Then, the principal investigator met with the head nurses to inform them that she will start data collection. Questionnaires were distributed to the nurses over the three shifts by the principle investigator at the beginning of each shift. All questions from the participants regarding the data collection instruments were answered. When the participants filled the questionnaire, it was collected by the principle investigator at the end of each shift.

2.4 Measurement of variables

2.4.1 Knowledge, attitude, barriers and sociodemographic

Data collection instrument consisted of two parts. Part one: Collected the following socio-demographics; age, gender, working area, educational level, years of experience, hospital type, if the participant received training about hand hygiene. Part two: assessed the participants hand hygiene knowledge, attitude and barrier of hand hygiene compliance.

2.4.2 Knowledge

Hand Hygiene Knowledge Questionnaire was used to assess the knowledge about hand hygiene. This instrument is based on the WHO Guidelines for Hand Hygiene in Health Care 2009. This scale consists of 25 questions; nine multiple choice, 12 yes/no, and four true/false. The knowledge of hand hygiene was scored as follows: each correct response was given one (1) point and each wrong response was given a score zero (0). The maximum score was 25. The total score for each respondent was expressed as a percentage of the maximum score. Respondents then were categorized into those with poor knowledge (<50%), moderate knowledge (50-69.9%) and good knowledge (>70%). The WHO instrument has been used extensively in the literature to measure knowledge about hand hygiene. [20, 25, 14]

2.4.3 Attitude

Nurses' attitude about hand hygiene instrument is composed of 10 items Likert 5-scale type in which the participant rated his/her attitude as (strongly agree (5), to strongly disagree (1). The scores ranged from 10-50, with higher scores indicating more positive attitude. The scores were considered as 10-23; low, 24-36; moderate, and 37-50; high. This instrument showed good psychometric proprieties, with Cronbach's alpha of 0.87. This instrument has been used previously in the literature to measure attitude regarding hand hygiene [29].

2.4.4 Barriers

There is no validated instrument that measure barriers of hand hygiene compliance. For this reason, this part was developed by researcher based on many steps. First, comprehensive review of literature was conducted to identify the barriers of hand hygiene among nurses [26, 12, 6, 20, 9, 14, 17]. Second; content validity was conducted by a panel of seven expert from Jordan and US. These experts are distributed as the following: two in critical care nursing, three in clinical practice and two are specialized academic and teaching filed professors. They evaluated each item relevancy and clarity. For clarity, the panel suggested to remove one item from the list "reword for support compliance". The explanation behind that was this is a portion of the nurses' job description. Content validity was conducted in term of relevancy of the items. Each expert rate each item for its relevancy on a scale of (strongly agree, agree, neutral, disagree, and strongly disagree). Content validity indexes (CVI) was calculated via SPSS version 21 as the method described by [27]. Seven raters were enrolled in the CVI calculation. First, item content validity index was calculated for each item through dividing the number of experts who had rate of either strongly agree or agree by total number of raters (table 1). Second, the scale CVI was calculated by averaging all item content validity index. Based on that the final scale CVI was 0.84.

Table 1: Content validity index values per item

#	Items/barriers	Agreement rate
1	Lack of knowledge and education	0.86
2	Empty hand hygiene products	1.0
3	Sinks/dispensers are not in convenient location	1.0
4	Insufficient time (high work load)	0.86
5	Skin irritation	1.0
6	Wearing gloves	0.86
7	Ignorance of guidelines	0.86
8	<i>Forgetfulness</i>	<i>0.57</i>
9	<i>Lack of role model from staff</i>	<i>0.57</i>
10	Lack of written guidelines	0.86
11	Lack of sanctions to non-compliance	0.86
12	<i>Lack of reward to support compliance</i>	<i>0.57</i>
13	Lack of climate that encourage safety	1.0
Total		0.84

According to Poilt & pick (2014), item content validity index I-CVI should be 1.00 with 3 to 5 experts, and a minimum of 0.78 for 6 to 10 experts. Moreover, the scale content validity index SCVI should be 0.90 or higher. Based on that, all items with I-CVI below 0.78 will be deleted from the scale. When these items (8, 9, and 12) were deleted, SCVI improved to 0.92. Based on that, the instrument that was used in this study to measure the barriers is presented in table 2.

Table 2: Barriers to hand hygiene compliance.

#	Items/barriers	Very important	Important	Somewhat Important	Not important	Totally not important
1	Lack of knowledge and education					
2	Empty hand hygiene products					
3	Sinks/dispensers are not inconvenient location					
4	Insufficient time (high work load)					
5	Skin irritation					
6	Wearing gloves					
7	Ignorance of guidelines					
8	Lack of written guidelines					
9	Lack of sanctions to non-compliance					
10	Lack of climate that encourage safety					

2.4.5 Data Analysis

Data were analyzed using Statistical Package for the Social Sciences version 21 (SPSS, 21). To test research questions one, two and five descriptive statistics ($M \pm SD$, or frequencies and percentages) were used. Moreover, for question number five; rank order was used to determine the most important barriers to hand hygiene. To test question number three, t-test or ANOVA with post hoc was used according to the number of categories in the grouping variable. To test research question number four, correlation coefficient was used.

3. Results

3.1 Sociodemographics

This study was conducted at ICU, ER, and medical/surgical wards of four major (two private, one teaching and one governmental) hospitals in Amman, Jordan. Two hundred and fifty questionnaires were distributed and 207 were returned back and included in the final analyses ending with 82.8% response rate. More than half of the sample was males (51.2%) with a mean age was 29.28 ± 5.65 . More than one third of the sample was from the governmental hospital (40%) and from the ICU (27%). The majority of the participants were bachelor's degree holders (93.2%) table 3.

Table 3: Sociodemographic characteristics of the sample (N=207)

Variable	Mean \pm SD or n (%)
Age	29.28 \pm 5.65
Years of experience	6.24 \pm 5.19
Gender	
Male	106(51.2)
Female	101(48.8)
Hospital type	
Private	61(29.5)
Teaching	63(30.4)
Government	83(40.1)
Area of practice	
ICU	56(27.1)
ER	47(22.7)
Medical word	49(23.7)
Surgical word	55(26.6)
Education level	

Bachelor	193(93.2)
Master	14(6.8)
Training course	
Yes	192(92.8)
No	14(6.2)

3.2 Research questions

1. What is the Jordanian nurses' Knowledge level about hand hygiene?

The total level of Knowledge for the whole sample was 13.83 ± 2.64 (55.32%) indicating moderate level of Knowledge according to the classification scores of WHO instrument; poor knowledge (<50%), moderate knowledge (50-69.9%) and good knowledge (>70%). Table 4 shows the detailed item by item correct answer with their percentages.

Table 4: Numbers and percentages of correct answers/Knowledge questionnaires (N=207)

No	Questions (answers)	N(%)
1.	Which of the following is the main route of transmission of potentially harmful germs between patients? (health care workers hands when not clean)	89 (43)
2.	What is the most frequent source of germs responsible for health care associated infections? (germs already present on or within the patient)	100 (48.3)
Which of the following hand hygiene actions prevents transmission of germs to the patient?		
3.	Before touching a patient (yes)	160 (77.3)
4.	Immediately after risk of body fluid exposure (yes)	86 (41.5)
5.	After exposure to immediate surroundings of a patient (no)	75 (36.2)
6.	Immediately before a clean/aseptic procedure (yes)	147 (71)
Which of the following hand hygiene actions prevents transmission of germs to the healthcare worker?		
7.	After touching a patient (yes)	160 (60.9)
8.	Immediately after a risk of body fluid exposure (yes)	176 (85)
9.	Immediately before a clean/aseptic procedure (no)	126 (60.9)
10.	After exposure to the immediate surroundings of a patient (yes)	165(79.7)
Which of the following statements on alcohol-based hand rub and hand washing with soap and water is true?		
11.	Hand rubbing is more rapid for hand cleansing than hand washing (true)	150 (72.5)
12.	Hand rubbing causes skin dryness more than hand washing (false)	36 (17.4)
13.	Hand rubbing is more effective against germs than hand washing (true)	72 (34.8)
14.	Hand washing and hand rubbing are recommended to be performed in sequence (false)	40 (19.3)
15.	What is the minimal time needed for alcohol-based hand rub to kill most germs on your hands? (20 seconds)	92 (44.4)
Which type of hand hygiene method is required in the following situations?		
16.	Before palpation of the abdomen (rubbing)	101 (48.8)
17.	Before giving an injection (rubbing)	115 (55.6)
18.	After emptying a bed pan (washing)	178 (86)
19.	After removing examination gloves (rubbing/washing)	92 (44.4)

20.	After making a patient's bed (rubbing)	89 (43)
21.	After visible exposure to blood (washing)	177 (85.5)
Which of the following should be avoided, as associated with increased likelihood of colonization of hands with harmful germs?		
22.	Wearing jewellery (yes)	170 (82.1)
23.	Damaged skin (yes)	171 (82.6)
24.	Artificial fingernails (yes)	177 (85.5)
25.	Regular use of a hand cream (no)	51 (42.1)

2. Do the Jordanian nurses have a positive attitude toward hand hygiene?

The total level of attitude for the whole sample was 32.74 ± 4.54 indicating average positive attitude according to the classification scores of attitude instrument toward hand hygiene (10-23; low, 24-36.9; moderate, and 37-50; high). Table 5 shows the detailed item by for nurse's attitude with their percentages.

Table 5: Detailed item by for nurse's attitude with their percentages.

#	Nurses' attitude toward hand hygiene	Strongly agree and Agree Percentage
1	I am tasked to act as a model about hand hygiene for other healthcare personnel.	39.1
2	It is more important for me to fulfill perfectly my tasks than doing hand hygiene when the given ward is busy.	68
3	Execution of hand hygiene may reduce mortality of patients under the recommended conditions.	46
4	Execution of hand hygiene may reduce the related medical costs to HAI infections under the commended conditions.	40.1
5	I could not always do hand hygiene under the recommended situations because of preference of my patients' requirements.	55
6	Prevention from the acquired infections is deemed as one of valuable roles for personnel of healthcare	47.3
7	I think one could follow the medical service officials in order to make decision for execution and or non-execution of hand hygiene.	54.6
8	The existing infectious diseases in health care-giving environment may threaten my life and occupation.	71.5
9	I think I have potential to change poor performance regarding hand hygiene in my workplace.	68
10	The hand hygiene is assumed as a habit in my personal life.	75

3. Is there any difference in knowledge /attitude levels based on selected sociodemographic (gender, hospital type, and working area)?

There was no statistically significant difference between males and females in regard to knowledge and attitudes. To check if there is a difference in knowledge and attitude based on hospital type, ANOVA with post hoc test was performed. There was a significant main difference in knowledge level ($F_{(2,204)} = 14.106$, $p < 0.001$). Post hoc analyses showed that nurses who were working in private hospital have higher levels of knowledge (15.11 ± 2.37) than nurses who work in teaching hospital (13.37 ± 2.33) who have higher levels of knowledge than nurses working in governmental hospital (12.87 ± 2.69) table 6.

ANOVA with post hoc test was performed to check if there is a difference in attitude levels based on hospital type. There was a significant main difference in attitude ($F_{(2,204)} = 7.08$, $p < 0.01$). Post hoc analyses showed that nurses who were working in the private hospital were responsible for the significant main effect. They have higher levels of attitude (34.52 ± 4.14) than nurses working in teaching (31.82 ± 4.62) and governmental hospital (32.14 ± 4.44) table 6.

There is no statistically significant result in regard to the different in knowledge based on working area. However, ANOVA with post hoc test showed that there was a significant main difference in attitude ($F_{(3,203)} = 11.92$, $p < 0.001$). Post hoc analyses showed that surgical nurses who were responsible for the significant main effect. They have higher levels of attitude (35.47 ± 4.63) than ICU nurses (32.55 ± 4.04) and higher levels than medical nurses (31.81 ± 4.00). On the other hand, ER nurses had showed lowest attitude (30.76 ± 4.14) table 6.

Table 6: Difference in knowledge and attitude levels based on gender, hospital type, and working area.

knowledge			
Hospital type	Compared with	Mean difference	P-value
Private	Teaching	1.74	.006
Teaching	Governmental	0.50	.018
Governmental	Private	-2.24	.000
Attitude			
Private	Teaching	2.70	.001
Teaching	Governmental	-0.32	NS
Governmental	Private	-2.38	.002
Attitude			
Working area	Compared with	Mean difference	P-value
ICU	ER	1.79	.034
Surgical	Medical	3.66	.000
ER	Surgical	-4.71	.000
Medical	ICU	-0.74	NS
ICU	Surgical	-2.92	.000
Medical	ER	1.05	NS

ICU: Intensive care units, **ER:** Emergency room, **NS:** Not significant.

4. Is there an association between knowledge /attitude and age, years of experience?

Person correlation coefficient was calculated to answer this question. There were no statistically significant results between (knowledge/attitude) and (age, years of experience)

5. What are the most important barriers toward hand hygiene among Jordanian nurses?

In order to answer this research question, we ranked order the items according to the level of importance. First (*very important*): 1) insufficient time, 2) skin irritation, 3) wearing gloves, 4) lack of knowledge, and 5) ignorance of guidelines. *Second (important)*: 1) ignorance of guidelines, 2) wearing gloves/lack of knowledge, 3) lack of sanction for non-compliance, and 4) lack of climate that encourage safety, table7.

Table 7: Numbers and percentages of hand hygiene barriers (N=207)

Items/barriers	Very important	Important	Somewhat Important	Not important	Totally not important
Insufficient time	122 (58.9)	51(24.6)	21 (10.1)	10 (4.8)	3 (1.4)
Skin irritation	144(55.1)	52(25.1)	21(10.1)	12 (5.8)	8 (3.9)
Wearing gloves	91 (44)	71(34.3)	24 (11.6)	15(7.2)	6 (2.9)
Lack of knowledge	63 (30.4)	71 (34.3)	38 (18.4)	20 (9.7)	15 (7.2)
Empty hand hygiene products	60 (29.0)	46(22.2)	41(19.8)	44 (21.3)	16 (7.7)
Ignorance of guidelines	54(26.1)	74(35.7)	46(22.6)	26 (12.6)	7 (3.4)
Lack of climate that encourage safety	50 (24.2)	63(30.4)	51 (24.6)	27 (13.0)	16 (7.7)
Lack of written guidelines	34(16.4)	48(23.2)	66 (31.9)	45 (21.7)	14 (6.8)
Sinks / dispensers not in convenient location	31 (15.0)	56(27.1)	52 (25.1)	49 (23.7)	19 (9.2)
Lack of sanctions to non-compliance	27(13.0)	68 (32.9)	52 (25.1)	41 (19.8)	19 (9.2)

4. DISCUSSION

The major findings of this study showed that nurses had a moderate level of knowledge and attitude. The most important barriers toward hand hygiene were: 1) insufficient time, 2) skin irritation, 3) wearing gloves, 4) lack of knowledge, and 5) ignorance of guidelines.

In this study the knowledge about hand hygiene practices was examined according to WHO guidelines. The knowledge score was 55.32 % which was considered as a moderate level. Comparing this result with previous studies done on the knowledge in other countries we found the following: Jordanian nurses' knowledge level was similar to previous study in Ghana and Srilanka [3, 18]. On the other hand, this result was lower than previous study in Iran and Nigeria. These two countries have good knowledge with rates of 74.5% in Iran [29] and 83% in Nigeria [11]. Moreover, previous study in Jordan among nursing student exhibited a higher average 79.17% which reported among nurses in our study [2].

Possible explanations for these differences included the method of data collection. The maximum number of questions in these studies was 10 items only. While in the current study, we used a questionnaire which was adopted from the WHO and contains 25 items. When the item number increased, the probability of getting lower results increased. Another possible explanation is the nature of the sample. Most of the participants in those two studies were working in critical area (ICU, CCU, and dialysis [29]. Usually those nurses have higher levels of knowledge compared to nurses working in other areas [12]. In addition, those two studies contained physician in the sample while our study only nurses. This might alter the results of these studies. Another possible explanation might be the sites of these studies. These two studies were conducted at educational hospitals which usually, provided opportunities to attend various seminars and training on infection control [11].

Comparing the results of this study with another study in a close by country with the same culture characteristics, Palestine, Jordanian nurses have higher knowledge level than Palestinian nurses (49%) [24]. The percentage of nurses that have training about infection control in our study was 93.2% compared to 51% in Palestine study. Previous studies demonstrated that infection control training improved hand hygiene knowledge [11]. More than half of the sample of the Palestinian nurses was from governmental hospitals compared to 40% in ours. The results showed that nurses working in private hospitals have higher levels of knowledge than those working in governmental hospitals [24].

In our study, 43% of the participants answered correctly when they were asked about the main route of

transmission of potentially harmful germs between patients. Our results are considered lower than those in Italy (95%) [26], Ghana (56.1%) [3], India (75.5%) [20] and Nigeria (98.8%) [11]. This might be because nurses considered hand hygiene as unnecessary action, done just when they see their hand are dirty [7].

Other results showed that 48.3% of Jordanian nurses knew that the most frequent source of germs responsible for HAI were the germs already present on or within the patient. This rate was considered higher than those in Ghana 27.2% [3], India 27% in [20], and Srilanka 25% [18]. This result indicated that Jordanian nurses thought the actual threat in hospital is the patients themselves more than any of environmental surrounding.

In this study, majority of the participants (72.5%) correctly answered that hand rubbing was more rapid than washing. However, they thought it causes skin irritation by (82.6%), while actually skin irritation is caused by frequent hand washing. In addition, they thought that hand rubbing and washing are recommended to be performed in sequences by (80.7%). Furthermore, only 34.8% recognized that hand rubbing is more effective than hand washing. About 44.4% knew that hand rubbing for 20 seconds was recommended to remove most germs from their hands which is consistent with the WHO guidelines. These results indicated that nurses lack necessary knowledge about appropriate using of hand rubbing and hand washing. Our finding was similar to other studies in Srilanka [18], India [20], and Ghana [3]. These studies showed gap of knowledge about appropriate using of hand rubbing and hand washing. Even though Jordanian nurses showed better knowledge than others regarding the recommended time for alcohol hand rubbing.

Hand washing can be replaced by hand rubbing in certain situations as: before palpation of the abdomen, before giving an injection and after making a patient's bed. More than half of respondent didn't answer correctly regarding to methods require before palpation of abdomen (51.2%), and after making a patient's bed (57%). However, 55.6% knew that hand rubbing was appropriate way before giving an injection.

These results are similar to previous studies in Ghana, Srilanka and India [20, 18, 3]. These results indicated that participants did not have enough awareness about using alcohol hand rub instead of hand washing and it is preferable in such situations [31]. Furthermore, majority of healthcare workers considered using soap and running water provided them sense of cleanliness, thus they preferred to use it more than hand rubbing which is not necessary in these situations [19].

Compliance with hand hygiene is an important issue. Most studies [3, 12, 18] showed that HCW lack the appropriate level of compliance including nurses. If nurses knew that hand rub can replace hand washing in these situations, compliance can be improved since hand rub require less time, no need for sink and water and more effective in killing germs [3].

Hand hygiene after removing gloves is an essential aspect as per WHO hand hygiene guidelines [31]. In our study, only 44.4% realized the need to perform hand hygiene after removing gloves. Only 22.5% of Egyptian nurses reported a need to performed hand hygiene after removing gloves. Furthermore, 38% of HCW in USA did not wash their hands after removing gloves even when they contacted body fluids [32]. These results indicated that nurses lack this type of knowledge.

In contrast, previous studies carried out in other countries showed nurses' awareness for doing hand hygiene after removing gloves were 87.4% in Italy, 99% in Ghana, 85% in Srilanka and 82.2% in India [26, 20, 18, 3]. Furthermore, previous study in Jordan showed that about 97% of nursing student knew the need to do hand hygiene after removing gloves [2].

The explanation of our result that nurses believed wearing gloves prevent visible dirt to get to their hands [19].

They thought that gloves can replace hand hygiene and so they didn't do it after removing the gloves [20, 26, 4]. Nursing students have higher levels of knowledge regarding this point. This is because they are still under study which is given to them by professional people. Clinical instructors and faculty members are usually giving the ideal situation for the students during the classroom or in laboratory setting. In the clinical setting, the situation is totally different. The nurses lose this theoretical knowledge because they are usually overloaded [24].

Only 41% of nurses knew that hand hygiene after risky body fluid (blood, urine, etc...) protect patient. Compared with 85% knew that hand hygiene after risky body fluid protect healthcare worker. In fact, hand hygiene after a risk of body fluid exposure prevents transmission of germs to both patients and HCW. But our results indicated that nurse concerning about conditions threatening their own health than conditions threatening their patients' health. That nurse's major concern was to protect themselves [2, 12].

In our study about 75% of the nurses recognized that performing hand hygiene before touching patient protect patient. In addition, 77.3% recognized that performing hand hygiene after touching the patient protect healthcare workers. These results were consistent with findings of previous studies in Ghana, Indian, Srilanka and Italy [3, 20, 18, 26]. These results indicated that nurses are more concerned to protect themselves than the patients [2].

Majority of participant did not know the necessity of regular use hand cream. They thought the regular use of hand cream was associated with germs colonization; which is not correct. In contrast, participant in studies conducted in Ghana, Indian, and Srilanka [3, 20, 18] preferred using regular hand cream to prevent skin damage from using hand hygiene products. The reason for our finding that participant in our study believed hand that cream has an effect on efficacy of hand hygiene product. Contrary, the regular use of hand cream was approved as associated with decrease incidence protect skin and reduce germs shedding that may happen when repeated using hand hygiene product [26, 31]

Our result showed that nurses who worked in private hospital had significantly higher level of knowledge than nurses who worked in teaching hospital who have higher levels of knowledge than nurses worked in governmental hospital. This result is comparable with study conducted in Palestine which showed better knowledge among nurses who worked in private hospital compared to governmental nurses. In addition the finding of previous studies in Ghana, Srilanka, Nigeria and Egypt [3, 11, 12, 18] which were conducted in teaching hospitals showed moderate to high level of knowledge.

Working in a teaching hospital provides a lot of opportunities to attend various seminars and training on infection control. This might lead to better knowledge of hand hygiene than their counterparts [11]. Nevertheless, level of knowledge about hand hygiene among HCW workers in Elgalaa governmental hospital was 73.1% and in Cleopatra private hospital was 72.7%. [12]. The explanation for our results were that private and teaching hospitals had continuous education regarding hand hygiene [24, 11]. In addition, the private hospital which participated in our study was Joint Commission International Accreditation (JCIA) which concern about implementation of patient safety aspect that includes hand hygiene. In contrast the educational and governmental were not accredited.

The attitude about hand hygiene affects the hand hygiene compliance either positively or negatively. On the other hand, knowledge also can affect the attitude on same direction. In this study, the attitude about hand hygiene was 65.28% indicating average positive attitude toward hand hygiene. This result is similar to previous study in Jordan which reported moderate attitude 65.48% and in Palestine which reported moderate

67.98%. However, the nursing student in Jordan showed better attitude 71.85% than nurses [2]. Furthermore, nurses in Iran, Egypt and Nigeria reported better attitude toward hand hygiene compared to Jordanian nurses [29, 11, 12].

The explanation why other studies have higher attitudes than ours is due to the nature of the sample which is a mixture of nurses and physician and the methods of data collection. We used 10 items questionnaire and they used only 5 items questionnaire to measure the attitude. These differences may alter the results between the samples. Attitudes of nurses are correlated with nurses' knowledge, which was found to influence hand hygiene compliance [7, 2].

The positive attitude level exhibited by Jordanian nurses was consistent with their moderate knowledge level. In addition, the results of knowledge level of this study gave further support to this correlation. Nurses in private hospitals have higher knowledge than those in governmental hospitals which reflects better attitude than governmental [24].

It is noted that 54.6% of the nurses followed the administration orders to make decision for execution and/ or non-execution regarding hand hygiene. This percentage was similar to previous study in Iran [29] but it was lower than those in, Egypt and Nigeria [12, 11]. The explanation of this result that administration has the responsibility to monitor HCW compliance and be assertive when they do not follow guidelines [7, 2]. However, healthcare workers did not support administrative monitoring interventions which involving rewards and punishments, and they preferred interventions that made hand hygiene easier [11].

In our study, 65.2% nurses showed potential to change poor performance regarding hand hygiene in their workplace. This result is comparable to the study which was conducted in Iran which revealed that 71.5% agreed to improve the performance [29]. Nevertheless, it was higher than 56% of Indian nurses [20] and 37.5% of healthcare worker in Srilanka [18]. The reason for this finding towards hand hygiene reported by nurses may be attributed to their knowledge of the consequences of poor hand hygiene compliance, which threaten them, their families, and their patients [7, 11].

Overall hand hygiene compliance rate is approximately 50% or less [9]. This low level of compliance is usually related to barriers of the compliance. More than 58.9% of the respondents reported that insufficient time was the most important barrier that prevents nurses to perform hand hygiene when recommended. This result is consistent with previous study in Rural India which should that 73% of the nurses reported being overburdened by work hindering proper hand hygiene as recommended [9].

Different studies in US. [32], Canada (Muller, et al. 2015), Belgium, [8], Nigeria [11], Ghana [3], India [20], Canada and US [17, 29], Egypt [19], reported that workload is and the most important barrier to perform hand hygiene. The explanation of his result is due to scarcity of nurses who have high workload duties and limited time. So, nurses usually prefer to perform their patients' care rather than performing hand hygiene [6].

About 55.1% of nurses in this study didn't comply to hand hygiene due to skin irritation, which may happen when using hand hygiene product. This result is comparable with previous study in Jordan, which showed that skin irritation was the highest predictor to hand hygiene non-compliance among healthcare professional [2]. Another study in Jordan revealed the same result that skin irritation was a predictor of hand hygiene non-compliance [7]. Moreover, 58.8% in Italian, 32% of Canadian and American HCW considered skin irritation as a burden to hand hygiene compliance [17]. The same result was reported by 40% of Indian nurses in bohpal that hand hygien agents cause irritation and dryness [20].

Consistent finding was reported among nurses in Egypt, and Canada [19, 6]. The high percentage of non-compliance due to skin irritation might be due to two reasons: 1) nurses did not believe that hand rubbing is less irritant than hand washing, and 2) lack of hand hygiene product that contains emollient with limited resources in developing country [7, 26].

In our study wearing gloves was one of the most important barriers. Forty four percent of the participants reported that wearing gloves substitute doing hand hygiene. Comparable finding among nursing students in Jordan since 36.8% of the sample deemed using of gloves can replace the need for hand hygiene [2]. Another study supporting this idea showed that 38% HCW in US did not do hand hygiene after removing gloves [32]. In contrast just 11.6% in Ghana [14], 15% in India [20], and 12.6% HCW in Italy [26] reported wearing gloves reduce the need for hand hygiene.

Lack of scientific information has critical impact on hand hygiene compliance. In our study 30.4% participants reported that they did not have sufficient knowledge. This finding was found also in previous studies Jordan [7], Saudi Arabia [21], India [20], Canada [17], Egypt [19], Palestine [24], and Ghana [3]. All of these studies exhibited gap of knowledge and recommended to follow continuous education and training to improve knowledge and practice.

Moreover, findings of US [17], Iran [29], and Nigeria [11] showed sufficient knowledge due to continuous training on infection control. This is reflected by a significant positive influence on attitudes. Contrary, the finding of previous study in Italy revealed improving hand hygiene compliance should be focused on facilitating the presence of hand hygiene products than educational interventions which seem ineffective [26]. Although, it is worthy to note higher level of hand hygiene knowledge does not necessarily equate improved hand hygiene practice. In contrast, inadequate hand hygiene knowledge is a factor that can have negative outcomes on hand hygiene compliance [2].

Scarceness of hand hygiene products was deemed as one of the important barriers related to hand hygiene compliance. In our study 29% of the participants reported that shortage of hygiene products in their working area. In the same way, 33% in Canada and US [17] reported empty hand hygiene product. Seventy one percent of Indian nurses [20] reported absence of soap. Sixty percent of sinks did not have soap in Egypt [12]. Moreover, Egyptian nurses reported poor compliance of hand hygiene due to a shortage of products [19]. Sixty three percent in rural India [9] reported inaccessible hand washing supplies. Fifty five percent of participants in Sri Lanka were not satisfied of product availability [18]. In Ghana, 19% of the nurses reported lack of detergent [3].

Our finding showed that 16.4% of participants deemed lack of written guidelines in working area a reason for non-compliance. Similarly, 40% of rural Indian nurses exhibited absence of hand hygiene instructions was barrier for hand hygiene compliance [8]. Furthermore, 81.3 % of Indian nurses and 93% of Italian nurses reported that hand hygiene instructions are necessary in working area for a correct hand hygiene practice [20, 26].

Convenient location of Sinks / dispensers is important issue in hand hygiene compliance. In our study, 15% of participants revealed that sinks / dispensers were not accessible. Comparable result was reported by 40% of HCW in US and Canada [17]. Moreover, 35% of nurses in India [20], and 8.2% HCW in Ghana [3], reported the same results. When the sinks are not in appropriate location, nurses start to search for sinks or dispensers in another location as a workaround. Usually, nurses were distracted on their way to find a sink and, as a

result, started a new task without performing hand hygiene [6].

In our study 13% of participants considered lack of sanction for noncompliance a barrier for hand hygiene compliance. In India, 42% of nurses showed their agreement to punish who did not comply hand hygiene [9]. Furthermore, previous study in Jordan supported sanction for any health care worker who did not comply with hand hygiene guidelines [7]. Also, in previous study in Egypt, participants believed that hand hygiene compliance can be improved by administrative orders. However, Nigerian HCW did not prefer interventions of rewards or sanction but they were in favor with promoting health education on infection control and easy accessibility to hand hygiene products [11].

5. CONCLUSION

The present study described Jordanian nurses' knowledge, attitudes and barriers toward hand hygiene. The result showed that the nurses had moderate level of knowledge and attitude regarding hand hygiene. Also, the results revealed that private hospitals nurses have higher levels of knowledge and attitude than nurses who work in teaching and governmental hospital. Moreover, this study showed the important hand hygiene barriers which lead to noncompliance. Finally, we recommend in this study that infection control topics be incorporated in curriculum and to carry out interventional program in clinical setting, which include educational, environmental and administrative strategies to improve hand hygiene compliance.

6. References

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