



# The Open Public Health Journal

Content list available at: <https://openpublichealthjournal.com>



## RESEARCH ARTICLE

### Assessing Hand Hygiene Practices Among Nurses in the Kingdom of Saudi Arabia

Mohammed AL Mohaithef<sup>1,\*</sup>

<sup>1</sup>Department of Public Health, Saudi Electronic University, Riyadh, Saudi Arabia

#### Abstract:

#### Background:

Hand hygiene is a simple and effective practice that reduces the transmission of hospital acquired infections. However, adherence to hand hygiene guidelines among health care professionals is low. The aim of this study is to assess hand hygiene practices among nurses working in hospitals in the Kingdom of Saudi Arabia.

#### Methodology:

The standardized version of the World Health Organization (WHO) questionnaire was administered to nurses from six hospitals in the region of Asir.

#### Results:

300 nurses were approached to enroll 243 participants so the response rate was 81%. The study found that 65.4% (159) of the participants followed a good hand hygiene practice while 10.3% (25) showed inadequate hand hygiene practice. Good hand hygiene practice was found to be significantly higher among female participants (88%) than the male participants (44%). The participants from the department of internal medicine (43.5%) showed the highest percentage of inadequate hand hygiene practice while participants from the department of pediatrics reported a 100% good hand hygiene practice.

#### Conclusion:

The male nurses and nurses working in the department of internal medicine require in-service educational intervention regarding hand hygiene to increase their compliance with its practice. Posters and other visual aids highlighting the significance of hand hygiene need to be displayed in all the departments to sensitize the importance of hand hygiene among nurses.

**Keywords:** Hand hygiene, Nurse, Hospital acquired infection, Health care professionals, Alcohol-based hand rub, Hand washing.

#### Article History

Received: January 26, 2020

Revised: April 04, 2020

Accepted: April 04, 2020

## 1. INTRODUCTION

Hand hygiene is a simple and important procedure that prevents the spread of healthcare-associated infections within hospital settings. As a cost-effective intervention, hand hygiene plays a vital role in infection control and ensures the safety of patients in health care organizations [1]. It is estimated that more than 1.4 million people across the globe are affected due to hospital acquired infections [2].

The World Health Organization projects that the prevalence of hospital acquired infections is about 5-10% in the

developed countries and roughly 40% in the developing countries [3]. The previous literature declares that the burden of hospital acquired infection among underdeveloped nations is predominantly high [4]. The previously published literature substantiates that washing hands with soap and water or using alcohol-based hand rub are the most effective methods for preventing the transmission of infectious diseases [5].

There is sufficient evidence from the previously published literature mentioning that infections can cause severe adverse effects on patients and can result in prolonged hospital stays, pneumonia and even death [6]. Furthermore, the presence of hospital acquired infections also increases the economic burden within households and raises the cost of the health care delivery system in the country [7]. Hands of the health care

\* Address correspondence to this author at the Department of Public Health, Saudi Electronic University, Riyadh, Saudi Arabia; Tel: +96650411933; E-mail: [m.almohaithef@seu.edu.sa](mailto:m.almohaithef@seu.edu.sa)

professionals are usually contaminated with pathogenic microbial organisms, which play a significant role in the transmission of infections from one person to another person within the hospital setting [8].

Among health care professionals, nurses constitute the majority of health care professionals and are considered to be the nucleus of the health care delivery system given as they are in direct contact with patients and spend more time with them [9, 10]. Health care associated infections are also a major public health problem in the Kingdom of Saudi Arabia. A study carried out by Abdel-Fattah *et al.* [11] in the Taif Al-Hada Armed Forces Hospital found that 668 out of 1382 hospitalized patients developed hospital acquired infections during their stay in the hospital. Similarly, a study conducted by Sabra *et al.* in Taif [12] between the years of 2010 to 2011 indicated that 48.3% of patients had developed hospital acquired infections.

There is considerable evidence from the previous literature indicating that strict hand hygiene practices among health care professionals can significantly reduce the incidence of hospital acquired infections [13 - 15]. However, several studies show that the compliance of hand hygiene among health care professionals is generally low [16, 17]. Also, the study by Kalata *et al.* [18] in hospitals in Malawi found that only 23% of the health care professionals adhered to hand hygiene practices.

The low adherence to hand hygiene practices acts as a major barrier to implementing infection control programs in hospitals. Moreover, there are no ideal methods available for monitoring the compliance of hand hygiene practices among health care professionals [19]. Therefore, the objective of this study is to assess the practices of hand hygiene among nurses in the Kingdom of Saudi Arabia and to find the association between the hand hygiene practices and the general demographic characteristics of nurses.

## 2. MATERIALS AND METHODS

### 2.1. Study Setting & Participants

A cross-sectional survey was administered to nurses in six selected hospitals in the Asir region of the Kingdom of Saudi Arabia from November 2017 to May 2018. The study used cluster sampling to select hospitals. The first 6 out of about 12 government-owned hospitals in the Asir region whose managers were available and facilitated the process of data collection were included in the study. Opportunistic sampling technique was used to recruit the study participants. From the selected hospitals, the nurses who had direct contact with patients were invited to participate in the study.

### 2.2. Sample Size Calculation

The sample size was calculated by using the Raosoft sample size calculator. The margin of error was kept 5% with a confidence interval of 95%, and a response distribution of good hand hygiene practice as 29.8% from a previous study from Saudi Arabia [20] with an anticipated frequency of nursing population of 1000. The minimum sample size calculated was 243.

### 2.3. Data Collection

The research team visited the selected hospitals and had a face to face discussion with the nurses specific to individual departments of the hospital during their break time. The nurses were briefed about the research and informed that their participation in this research is completely voluntary. The researchers also explained to nurses that the data collected would be used only for research purposes with utmost confidentiality. A written informed consent was obtained from each nurse at the time of enrollment.

Data was collected using the standard questions related to the practice of hand hygiene based on the WHO Guidelines on Hand Hygiene for Health care professionals [21]. Additional questions were included for collecting the general demographic information of participants such as age, gender, departments and years of experience.

The questionnaire was developed in English language and then translated into Arabic language for the purpose of research. All the nurses from the selected hospitals were provided with the online link where they can find the electronic version of the questionnaire in the Arabic language. The nurses were asked to complete and submit the questionnaire electronically.

### 2.4. Development of Questionnaire

#### 2.4.1. Scoring System for Practice

There were a total of 11 questions in the questionnaire that were given score 1 and 0 for right and wrong answers, respectively. If the participant answered "sometimes", it was considered as a wrong answer to reduce the effect of social desirability. The total score ranged from 0 to 11. The total score was divided into three categories: 'inadequate practice' (less than 6), 'adequate practice' (6 to 8) and 'good practice' (9 to 11).

**Good Practice:** The study participants who responded to the practice questions >75% in line with the suggested hand washing practice.

**Adequate Practice:** The study participants who responded to the practice questions up to 50-75% in line with the suggested hand washing practice.

**Poor Practice:** The study participants who responded to the practice questions <50% in line with the suggested hand washing practice.

### 2.5. Data Analysis

The data analysis was carried out by using SPSS (Version 16.0, SPSS Inc. Chicago, IL, USA). A frequency table was used to describe the self-reported practice of hand hygiene among nurses. Chi-square test/Fischer exact test was applied to nominal scales as applicable. The p-value <0.05 was considered to be statistically significant.

### 2.6. Ethical Approval

Ethical approval was obtained from the research ethics committee, College of Medicine, King Khalid University,

Abha, Asir region, (HA-06-B-001) Kingdom of Saudi Arabia. Official permission was obtained from the Ministry of Health-Asir region to conduct this study in the selected hospitals of the Asir region.

### 3. RESULTS

Three hundred nurses from the six hospitals were approached to recruit 243 nurses into the study, thus yielding a response rate of 81%. Table 1 shows the general demographic characteristics of the study participants. Among the 243 participants, 50.6% (123) belonged to the age group of 25-34 years, 38.3% (93) had clinical experience of about 6 to 10 years. Majority of the participants 77.8% (189) had undergone

a training course on hand washing.

Participants' responses to the practice questionnaire are described in Table 2. Nearly 69% (167) of the participants claimed to routinely wash their hands and 69.1% (168) claimed to use alcohol-based hand rubs. The highest percentages of hand wash practice reported by the participants were 91.4% (222) after exposure to body fluids, followed by 88.5% (215) when their hands look dirty and 87.2% (212) after exiting an isolation room. The lowest percentages of hand wash practice reported by the participants were 70.8% (172) after physical contact with patients, followed by 72.4% (176) before any medical procedures and 73.3% (178) before entering an isolation room.

**Table 1. General demographic characteristics of nurses who responded practice questionnaire regarding hand hygiene (N=243).**

Variable	(%)
Gender	
Male	126 (51.9%)
Female	117 (48.1%)
Age (years)	
20-24	13 (5.3%)
25-34	123 (50.6%)
35-44	81 (33.3%)
45-54	26 (10.7%)
Department	
Internal medicine	23 (9.5%)
Surgery	32 (13.2%)
Intensive care unit	31 (12.8%)
Mixed medical/surgical	36 (14.8%)
Emergency unit	39 (16%)
Obstetrics	13 (5.3%)
Pediatrics	12 (4.9%)
Long-term/rehabilitation	28 (11.5%)
Outpatient clinic	29 (11.9%)
Working Experience (years)	
1-5	56 (23%)
6-10	93 (38.3%)
11-15	58 (23.9%)
>15	36 (14.8%)
Attend a training course about hand washing	
Yes	189 (77.8%)
No	31 (12.8%)
Not Sure	23 (9.5%)

**Table 2. Nurses responses to the practice questionnaire (N=243).**

Hand Hygiene Practices	(%)
Do you routinely wash your hands?	
Yes	167 (68.7%)
No	13 (5.3%)
Sometimes	63 (25.9%)
Do you routinely use an alcohol-based hand rubs for hand hygiene?	
Yes	168 (69.1%)
No	22 (9.1%)
Sometimes	53 (21.8%)

(Table 2) cont.....

Hand Hygiene Practices	(%)
Do you wash your hands in the following situation?	
a. After physical contact patient with patients	
Yes	172 (70.8%)
No	19 (7.8%)
Sometimes	52 (21.4%)
b. After exposure to body fluids	
Yes	222 (91.4%)
No	07 (2.9%)
Sometimes	14 (5.8%)
c. Before any medical procedures	
Yes	176 (72.4%)
No	27 (11.1%)
Sometimes	40 (16.5%)
d. If they look or feel dirty	
Yes	215 (88.5%)
No	10 (4.1%)
Sometimes	18 (7.4%)
e. Before entering an isolation room	
Yes	178 (73.3%)
No	36 (14.8%)
Sometimes	29 (11.9%)
f. After exiting an isolation room	
Yes	212 (87.2%)
No	22 (9.1%)
Sometimes	09 (3.7%)
g. After removing gloves	
Yes	195 (80.2%)
No	13 (5.3%)
Sometimes	35 (14.4%)
h. After going to the toilet	
Yes	209 (86%)
No	19 (7.8%)
Sometimes	15 (6.2%)
i. After touching potentially contaminated objects	
Yes	208 (85.6%)
No	03 (1.2%)
Sometimes	32 (13.2%)

Table 3 shows the distribution of participants according to hand hygiene performances. The self-reported responses to the hand hygiene questionnaire in the study found that 65.4% (159) of the participants followed a good hand hygiene practice (>75% responses are in line with the suggested hand washing practice) while 10.3% (25) showed inadequate hand hygiene practice (<50% responses are in line with the suggested hand washing practice).

The association between participants self-reported practices on hand hygiene and the general demographic variables is indicated in Table 4. In the study, good hand hygiene practice was found to be significantly higher among female participants (88%) than male participants (44%) when compared with inadequate (3.4% vs 16.7%) and adequate practice (38.9% vs 8.6%)(p<0.0001). The participants in the age group 25-34 years showed a significantly lower percentage

of good hand hygiene practice (56.1%) than 45-54 years (84.6%) when compared with adequate practice (33.3% vs 15.4%) (p=0.038). The participants with 11-15 years of experience showed a significantly lower percentage of good hand wash practice (58.6%) than above 15 years of experience (77.8%) when compared with inadequate (25.9% vs 0%) and adequate practice (15.5% vs 22.2%) (p=0.003 & 0.0006 respectively). The participants following good hand hygiene practice (67.2%) had significantly higher exposure to training course than participants with adequate practice (22.2%) (p=0.002)

The participants from the department of pediatrics showed 100% good hand hygiene practice followed by obstetrics (92.3%) and mixed medicine & surgery (77.8%). The participants from the department of internal medicine (43.5%) showed the highest percentage of inadequate hand hygiene practice.

**Table 3. Distribution of nurses according to performance of hand hygiene (N=243).**

Hand Hygiene Practice Score	(%)
Inadequate Practice (<6)	25 (10.3%)
Adequate Practice (6-8)	59 (24.3%)
Good Practice (9-11)	159 (65.4%)

**Table 4. Correlation between the practice of nurses regarding hand hygiene and general demographic variables (N=243).**

Variables	Hand Hygiene Practices Score			Total N (Percent)	P-Value		
	Inadequate Practice (1)	Adequate Practice (2)	Good Practice (3)		1 vs 2	1 vs 3	2 vs 3
Gender	21 (16.7%)	49 (38.9%)	56 (44.4%)	126 (100%)	1.000	0.0001*	0.0001*
Male	04 (3.4%)	10 (8.6%)	103 (88.0%)	117 (100%)			
Female							
Age	01 (7.7%)	01 (7.7%)	11 (84.6%)	13 (100%)	0.333	0.353	1.000
20-24	13 (10.6%)	41 (33.3%)	69 (56.1%)	81 (100%)	0.565	0.065	0.038*
25-34	11 (13.6%)	13 (16.1%)	57 (70.4%)	26 (100%)	0.132	0.059	1.000
35-44	0 (0.0%)	04 (15.4%)	22 (84.6%)		Ref	Ref	Ref
45-54							
Years of Experience	04 (7.1%)	15 (26.8%)	37 (66.1%)	56 (100%)	0.286	0.141	0.623
1-5 Years	06 (6.5%)	27 (29.0%)	60 (64.5%)	93 (100%)	0.323	0.174	0.384
6-10 Years	15 (25.9%)	09 (15.5%)	34 (58.6%)	58 (100%)	0.003*	0.0006*	1.000
11-15 Years	0 (0.0%)	08 (22.2%)	28 (77.8%)	36 (100%)	Ref	Ref	Ref
>15 Years							
Attend a training course about hand washing	20 (10.6%)	42 (22.2%) <sup>#</sup>	127 (67.2%) <sup>#</sup>	189 (100%)	0.591	0.075	0.002*
Yes	05 (16.1%)	15 (48.4%)	11 (35.5%)	31 (100%)			
No							

\*P value is significant at the level &lt; 0.05

<sup>#</sup>Difference in number of total participants due to removal of participants who were not sure about attending training course for hand washing.

#### 4. DISCUSSION

The current study was conducted to investigate the self-reported practices of hand hygiene among nurses in the Asir region in the Kingdom of Saudi Arabia. The World Health Organization (WHO) has compiled a questionnaire for increasing the compliance of hand hygiene and also to reduce the prevalence of hospital-acquired infections [22]. In the present study, it was found that 65.4% nurses followed good hand hygiene practice and 24.3% followed adequate hand hygiene practice while the study conducted in the central region of Saudi Arabia on nursing students reported a higher percentage of moderate hand hygiene practice (68.7%) and a lower percentage of good hand hygiene practice (29.8%) [20]. However the rate of inadequate or poor hand hygiene practice in the present study (10.8%) was similar to the study conducted on nursing students of the central region of Saudi Arabia (13.1%). The differences in the hand hygiene practice may be due to the difference in subjects enrolled in the studies. A review article by Kendall *et al.*, 2012 reported that the compliance of hand hygiene among health care professionals in Canada is low [23]. Similarly, two other studies pointed out that compliance of hand hygiene among nurses is poor and highly influenced by the heavy workload, a high number of clinical procedures and skin conditions [24, 25]. Furthermore, several studies that were carried out in Saudi Arabia, Sri Lanka, Ethiopia, and other countries showed that a hand hygiene compliance rate among the health care professionals varies between 5.53% to 87.5% [20, 26 - 31].

Regarding the relation between gender and self-reported hand hygiene practices, the results of the present study showed female nurses as having a significantly higher good hand hygiene practice than male nurses. These results are in accordance with other studies, which also showed similar significant differences in the performance of hand hygiene between males and females [32 - 35]. Similarly, the study by Cruz *et al.*, 2015 recognized that the mean score for hand

hygiene practice varies between males and females [36]. However, the higher compliance rate of hand hygiene among females may also be associated with their propensity to practice socially acceptable behaviors [37, 38].

In the present study, it was found that the nurses working in the Pediatric and Obstetric department followed good hand hygiene practice; this may be due to their regular involvement with the most vulnerable population to hospital-associated infection. The nurses in the department of Internal Medicine showed inadequate hand hygiene practice which may be due to the workload. Frequent hand hygiene training sessions to nurses are needed in the department of internal medicine to encourage them to observe and follow up correct hand hygiene practices.

In the present study, 77.8% of nurses self-reported to have attended training courses for hand hygiene practices, which was reflected in the higher percentage of good hand wash practice by 65.4%. The study done by Mazi *et al.*, 2013 [39] on 1,975 health care professionals in Taif, Saudi Arabia asserted that there was an increase in hand hygiene compliance from 51% to 67% between May to June 2010 after an intervention campaign. A study by Cruz *et al.*, 2015 mentioned that there is a need for gender-specific educational intervention in order to address gender disparity [36].

A study by Randle *et al.*, 2006 [40] has confirmed that the practice of hand hygiene among health care workers can be enhanced significantly through regular hand hygiene training using different educational materials to remind health care workers of hand hygiene. Shinde *et al.*, 2014 [41] advocated the need for training programs on hand hygiene at regular intervals by using the materials provided by the World Health Organization and also the need for active participation of infection control team in order to create awareness about hand hygiene and to build the supportive environment for improving the practice of hand hygiene within hospitals.

## 5. LIMITATIONS

The main limitation of the current study is that the results are based on self-reported questionnaire. There may be an exaggeration of hand hygiene compliance among nurses especially those who have attended the training course for hand washing. Moreover, there is a possibility of social desirability bias [42] as the study was conducted in hospital setting among nursing professionals. Therefore, to reduce the effect of social desirability to some extent, the participants' response "sometimes" was considered as a negative response. Another limitation of the study is that no proxy measures like hospital-acquired infection rates of different departments, and access to hand hygiene facilities of nurses in different departments were not assessed in the study to validate the self-reported hand hygiene practice. However, a previous study [43] reported that the self-reported hand hygiene compliance rate can be considered as an acceptable substitute when there exist cost and time constraints. Lastly, the participants in the study were enrolled using the opportunistic sampling technique, which limits the generalizability of results.

## CONCLUSION

This study was conducted to assess the self-reported practices of hand hygiene among nurses. 65.4% of nurses in this study followed good hand hygiene practices. The male nurses and nurses working in the department of internal medicine need in-service educational intervention regarding hand hygiene to increase their compliance with hand hygiene practices. Posters and other visual aids highlighting the significance of hand hygiene need to be displayed in all the departments to sensitize the importance of hand hygiene among nurses.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the research ethics committee, College of Medicine, King Khalid University, Abha, Asir region, (HA-06-B-001) Kingdom of Saudi Arabia.

## HUMAN AND ANIMAL RIGHTS

Not applicable.

## CONSENT FOR PUBLICATION

All participants participated on a voluntary basis and gave their informed consent.

## AVAILABILITY OF DATA AND MATERIALS

The original data collected using questionnaires used to support the findings of this study shall be available from the corresponding author [M. A.] upon request.

## FUNDING

None.

## CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

## ACKNOWLEDGEMENTS

We would like to express our sincere gratitude to the Deanship of Scientific Research, Saudi Electronic University, Riyadh, Kingdom of Saudi Arabia for their continuous and incredible support throughout this research.

## REFERENCES

- [1] Colet PC, Cruz JP, Cruz CP, Al-Otaibi J, Qubeilat H, Alquwez N. Patient safety competence of nursing students in Saudi Arabia: A self-reported survey. *Int J Health Sci (Qassim)* 2015; 9(4): 418-26. [<http://dx.doi.org/10.12816/0031231>] [PMID: 26715921]
- [2] Sallami ZA. Assessment of hand hygiene attitude, knowledge and practice among health science students in aden university. *J Biosci and Med* 2016; 6:4:25
- [3] World Health Organization. Improved hand hygiene to prevent health care associated infections [http://www.who.int/gpsc/tools/faq/evidence\\_hand\\_hygiene/en/2014](http://www.who.int/gpsc/tools/faq/evidence_hand_hygiene/en/2014) Available from:
- [4] Al Kadi A, Salati SA. Hand hygiene practices among medical students. *Interdiscip Perspect Infect Dis* 2012; 2012679129 [<http://dx.doi.org/10.1155/2012/679129>] [PMID: 23024653]
- [5] Anderson JL, Warren CA, Perez E, *et al.* Gender and ethnic differences in hand hygiene practices among college students. *Am J Infect Control* 2008; 36(5): 361-8. [<http://dx.doi.org/10.1016/j.ajic.2007.09.007>] [PMID: 18538703]
- [6] Glance LG, Stone PW, Mukamel DB, Dick AW. Increases in mortality, length of stay, and cost associated with hospital-acquired infections in trauma patients. *Arch Surg* 2011; 146(7): 794-801. [<http://dx.doi.org/10.1001/archsurg.2011.41>] [PMID: 21422331]
- [7] Zimlichman E, Henderson D, Tamir O, *et al.* Health care-associated infections: a meta-analysis of costs and financial impact on the US health care system. *JAMA Intern Med* 2013; 173(22): 2039-46. [<http://dx.doi.org/10.1001/jamainternmed.2013.9763>] [PMID: 23999949]
- [8] Gilbert K, Stafford C, Crosby K, Fleming E, Gaynes R. Does hand hygiene compliance among health care workers change when patients are in contact precaution rooms in ICUs? *Am J Infect Control* 2010; 38(7): 515-7. [<http://dx.doi.org/10.1016/j.ajic.2009.11.005>] [PMID: 20189682]
- [9] Buerhaus PI, Auerbach DI, Staiger DO. Recent trends in the registered nurse labor market in the U.S.: Short-run swings on top of long-term trends. *Nurs Econ* 2007; 25(2): 59-66. [PMID: 17500490]
- [10] Abualrub RF. Nursing shortage in Jordan: what is the solution? *J Prof Nurs* 2007; 23(2): 117-20. [<http://dx.doi.org/10.1016/j.profnurs.2006.07.008>] [PMID: 17383605]
- [11] Abdel-Fattah MM. Surveillance of nosocomial infections at a Saudi Arabian military hospital for a one-year period. *Ger Med Sci* 2005; 3: Doc06. [PMID: 19675723]
- [12] Sabra SM, Abdel-Fattah MM. Epidemiological and microbiological profile of nosocomial infection in Taif hospitals, KSA(2010-2011). *World J Med Sci* 2012; 7: 1-9.
- [13] Al-Tawfiq JA, Abed MS, Al-Yami N, Birrer RB. Promoting and sustaining a hospital-wide, multifaceted hand hygiene program resulted in significant reduction in health care-associated infections. *Am J Infect Control* 2013; 41(6): 482-6. [<http://dx.doi.org/10.1016/j.ajic.2012.08.009>] [PMID: 23261346]
- [14] Mestre G, Berbel C, Tortajada P, *et al.* "The 3/3 strategy": a successful multifaceted hospital wide hand hygiene intervention based on WHO and continuous quality improvement methodology. *PLoS One* 2012; 7(10):e47200 [<http://dx.doi.org/10.1371/journal.pone.0047200>] [PMID: 23110061]
- [15] Rosenthal VD, Guzman S, Safdar N. Reduction in nosocomial infection with improved hand hygiene in intensive care units of a tertiary care hospital in Argentina. *Am J Infect Control* 2005; 33(7): 392-7. [<http://dx.doi.org/10.1016/j.ajic.2004.08.009>] [PMID: 16153485]
- [16] Thakker VS, Jadhav PR. Knowledge of hand hygiene in undergraduate medical, dental, and nursing students: A cross-sectional survey. *J Family Med Prim Care* 2015; 4(4): 582-6. [<http://dx.doi.org/10.4103/2249-4863.174298>] [PMID: 26985420]
- [17] Ariyaratne MH, Gunasekara TD, Weerasekara MM, Kottahachchi J, Kudavidanage BP, Fernando SS. Knowledge, attitudes and practices of hand hygiene among final year medical and nursing students at the

- University of Sri Jayewardenepura. *Sri Lankan Journal of Infectious Diseases* 2013; 6: 3.  
[http://dx.doi.org/10.4038/sljid.v3i1.4761]
- [18] Kalata NL, Kamange L, Muula AS. Adherence to hand hygiene protocol by clinicians and medical students at Queen Elizabeth Central Hospital, Blantyre-Malawi. *Malawi Med J* 2013; 25(2): 50-2. [PMID: 24098831]
- [19] Eveillard M, Hitoto H, Raymond F, *et al.* Measurement and interpretation of hand hygiene compliance rates: importance of monitoring entire care episodes. *J Hosp Infect* 2009; 72(3): 211-7. [http://dx.doi.org/10.1016/j.jhin.2009.03.025] [PMID: 19481837]
- [20] Jonas P. Cruz, Meshrif A. Bashtawi. Predictors of hand hygiene practice among Saudi nursing students: Across-sectional self-reported study. *J Infect Public Health* 2016; 9: 485-93. [http://dx.doi.org/10.1016/j.jiph.2015.11.010] [PMID: 26707706]
- [21] Hand Hygiene WHO. Why, How & When? Patient safety, a world alliance for safer health care, save lives, cleans your hands A questionnaire developed by infection control programme, Hôpitaux Universitaires de Genève English Version. World Health Organization 2009.
- [22] WHO Guidelines on Hand Hygiene in Health Care First Global Patient Safety Challenge Clean Care is Safer Care. 2009.
- [23] Kendall A, Landers T, Kirk J, Young E. Point-of-care hand hygiene: preventing infection behind the curtain. *Am J Infect Control* 2012; 40(4)(Suppl. 1): S3-S10. [http://dx.doi.org/10.1016/j.ajic.2012.02.009] [PMID: 22546271]
- [24] Abd Elaziz KM, Bakr IM. Assessment of knowledge, attitude and practice of hand washing among health care workers in Ain Shams University hospitals in Cairo. *J Prev Med Hyg* 2009; 50(1): 19-25. [PMID: 19771756]
- [25] Jang JH, Wu S, Kirzner D, *et al.* Focus group study of hand hygiene practice among healthcare workers in a teaching hospital in Toronto, Canada. *Infect Control Hosp Epidemiol* 2010; 31(2): 144-50. [http://dx.doi.org/10.1086/649792] [PMID: 20017635]
- [26] Aledeilah R, Abo el-Fetoh N, Albaker A, *et al.* Assessment of Knowledge, Attitude and Practice of Hand Hygiene among Health Care Workers in Arar City, Saudi Arabia. *Egyptian Journal of Hospital Medicine* 2018; 70: 491-8. [http://dx.doi.org/10.12816/0043494]
- [27] AlOmari F., AlQarny M.. Knowledge and practice of hand hygiene among healthcare workers at Armed Forces Military Hospitals, Taif, Saudi Arabia. *Int J Med Sci Public Health* 2015; 5: 1282-91.
- [28] Engdaw GT, Gebrehiwot M, Andualem Z. Hand hygiene compliance and associated factors among health care providers in Central Gondar zone public primary hospitals, Northwest Ethiopia. *Antimicrob Resist Infect Control* 2019; 8: 190. [http://dx.doi.org/10.1186/s13756-019-0634-z] [PMID: 31788237]
- [29] Jemal S. Knowledge and Practices of Hand Washing among Health Professionals in Dubti Referral Hospital, Dubti, Afar, Northeast Ethiopia *Advances in preventive medicine* 2018; 2018: 5290797. [http://dx.doi.org/10.1155/2018/5290797]
- [30] Goyal L, Kumar A, Goyal T. Knowledge, attitude and practices towards hand hygiene among nursing staff working in a tertiary care setting in north India: a Descriptive cross-sectional study. *Eur J Pharm Med Res* 2018; 5: 255-9.
- [31] Sharif A, Arbabisarjou A, Balouchi A, Ahmadidarrehshima S, Kashani HH. Knowledge, Attitude, and Performance of Nurses toward Hand Hygiene in Hospitals. *Glob J Health Sci* 2016; 8(8): 53081. [PMID: 27045398]
- [32] Ahmed J, Malik F, Memon ZA, *et al.* Compliance and Knowledge of Healthcare Workers Regarding Hand Hygiene and Use of Disinfectants: A Study Based in Karachi. *Cureus* 2020; 12(2)e7036 [http://dx.doi.org/10.7759/cureus.7036] [PMID: 32211269]
- [33] Elkhawaga G, El-masry R. Knowledge, Beliefs and Self-reported Practices of Hand Hygiene among Egyptian Medical Students: Does Gender Difference Play a Role? *Journal of Public Health in Developing Countries* 2017; 3: 418-25.
- [34] Arikani Akan O, Cetinkaya Y, Ozgultekin A, *et al.* National multi-center study to evaluate the baseline hand washing compliance in the intensive care units of three Turkish hospitals: differences between genders. *Am J Infect Control* 2004; 32.
- [35] Kinnison A, Cottrell RR, King KA. Proper hand-washing techniques in public restrooms: differences in gender, race, signage, and time of day. *Am J Health Educ* 2004; 35(2): 86-9. [http://dx.doi.org/10.1080/19325037.2004.10603614]
- [36] Cruz J, Cruz C, Al-Otaibi A. Gender differences in hand hygiene among Saudi nursing students. *Int J Infect Control* 2015; 11: 1-13. [http://dx.doi.org/10.3396/ijic.v11i4.029.15]
- [37] Johnson HD, Sholcosky D, Gabello K, Ragni R, Ogonosky N. Sex differences in public restroom handwashing behavior associated with visual behavior prompts. *Percept Mot Skills* 2003; 97(3 Pt 1): 805-10. [http://dx.doi.org/10.2466/pms.2003.97.3.805] [PMID: 14738345]
- [38] Suen LKP, So ZYY, Yeung SKW, Lo KYK, Lam SC. Epidemiological investigation on hand hygiene knowledge and behaviour: a cross-sectional study on gender disparity. *BMC Public Health* 2019; 19(1): 401. [http://dx.doi.org/10.1186/s12889-019-6705-5] [PMID: 30975130]
- [39] Mazi W, Senok AC, Al-Kahldy S, Abdullah D. Implementation of the world health organization hand hygiene improvement strategy in critical care units. *Antimicrob Resist Infect Control* 2013; 2(1): 15. [http://dx.doi.org/10.1186/2047-2994-2-15] [PMID: 23673017]
- [40] Randle J, Clarke M, Storr J. Hand hygiene compliance in healthcare workers. *J Hosp Infect* 2006; 64(3): 205-9. [http://dx.doi.org/10.1016/j.jhin.2006.06.008] [PMID: 16893593]
- [41] Shinde M, Mohite V. A Study to Assess Knowledge, Attitude and Practices of Five Moments of Hand Hygiene among Nursing Staff and Students at a Tertiary Care Hospital at Karad. *Int J Sci Res (Ahmedabad)* 2014; 3: 311-21.
- [42] Kupfer TR, Wyles KJ, Watson F, La Ragione RM, Chambers MA, Macdonald AS. Determinants of hand hygiene behaviour based on the Theory of Interpersonal Behaviour. *J Infect Prev* 2019; 20: 232-7. [http://dx.doi.org/10.1177/1757177419846286]
- [43] Vikke HS, Vittinghus S, Betzer M, *et al.* "Hand hygiene perception and self-reported hand hygiene compliance among emergency medical service providers: A Danish survey". *Scand J Trauma Resusc Emerg Med* 2019; 27(1): 10. [http://dx.doi.org/10.1186/s13049-019-0587-5] [PMID: 30722789]