



## Hand Hygiene and knowledge of Intensive Care Unit Visitors towards Hospital Acquired Infection

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### General Note

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## ABSTRACT

**Background:** Poor compliance with hand hygiene (HH) is associated with higher rates of hospital-acquired infection (HAI). **Aim:** to determine HH compliance of intensive care units (ICUs) visitors as well as knowledge of visitors towards HAI. **Methods:** This cross-sectional study utilized a self-administered questionnaire to collect demographic data and assess visitors' knowledge regarding HAI. Visitors were also directly observed to assess HH before entering and after exiting ICU. **Results:** A total of 381 persons participated in this study. Only 25.7% used antiseptic solution before entering the ICU. The mean knowledge score was  $5.08 \pm 2.09$ . Most respondents (81.4%) had moderate to high levels of knowledge, while 18.6% had a low level of knowledge. Compliance with HH was significantly associated with male gender ( $p = 0.009$ ), but not with level of knowledge. The level of knowledge was significantly associated with male gender ( $p = 0.005$ ) and educational level ( $p = 0.042$ ). **Conclusions:** Rate of visitors' compliance with HH was low and was not related to knowledge. Education of visitors about the importance of HH in preventing HAI is required. Reminders of HH should be used.

**Keywords:** compliance; hand hygiene; hospital-acquired infections; intensive care unit; nosocomial infection.

## 1. INTRODUCTION

Hospital-acquired infections (HAIs) may occur among admitted patients, particularly due to unwashed hands of persons dealing with them as physicians, nurses, or visitors (Pittet et al., 2006; Bartley and Streifel, 2010; Randle et al., 2010). Increased rate of HAIs represents a great challenge to health-care systems as these infections have been significantly associated with increased rates of mortality and morbidity as well as increasing the economic burden on the resources of health-care systems (Vu & Le, 2020; Albassri et al. 2020). To reduce the rate of HAIs, several measures have been adopted, particularly in intensive care units (ICUs) where most patients are debilitated or in critical condition. Among these preventive measures, hand hygiene (HH) is considered the cornerstone and the most effective single strategy (Sax et al., 2009; Allegranzi and Pittet, 2009).

It is customary to regard increased rate of HAIs as a marker of poor compliance with HH (Silvestri et al., 2005). The role of visitors to ICU as potential source of infection was studied by Birnbach and colleagues (2015) who cultured the dominant hand of 55 visitors. They correlated the culture results with HH immediately prior to the culture. They reported the presence of statistically significant differences in culture results between HH-compliant and HH-non-compliant visitors. Although their results showed that compliance with HH did not totally get rid of bacterial colonies on the dominant hands, the cultures of the HH-compliant visitors had not included pathogens commonly associated with HAI, and some of them yielded no bacterial growth on any of the cultures.

Hand hygiene includes hand washing with water and detergent and/or the use of alcohol-based hand sanitizers (Sax et al., 2009). Owing to the importance of HH in preventing HAIs, the World Health Organization - as well as other health-centered organizations such as the Centers for Disease Control and Prevention - published guidelines of HH requirements for health care workers (Pittet et al., 2009).

Unfortunately, studies have indicated that compliance with HH among health care workers is low and even improvement after interventions is not maintained and tends to drop (Erasmus et al., 2009). Moreover, a considerable proportion of healthcare workers were found to be not adequately aware of the importance of HH. Unlike health care workers, compliance with HH among hospital visitors has been evaluated only in very few papers and is rarely enforced before entering wards or ICUs (Al-Dorzi et al., 2014; Birnbach et al., 2012; Birnbach et al., 2015; Fakhry et al., 2012; Hobbs et al., 2016; Linam et al., 2019; Randle et al., 2013). Therefore, the present study was conducted with the aim of determining HH compliance of ICU visitors as well as knowledge of visitors towards HAI.

## 2. METHODS

### Study setting

This is a cross-sectional hospital-based study, which enrolled 381 visitors who attended adult intensive care units at King Fahad Specialist Hospital (KFSH), Tabuk city, Saudi Arabia. Tabuk City is a capital city located in Northwest Saudi Arabia. It has a population of 910030. King Fahad Specialist Hospital is a secondary hospital, and it is one of the main hospitals in Tabuk, with a bed capacity of 500 beds.

All visitors were selected randomly. Inclusion criteria were participants aged above 18-years-old, male and female, who attended to adult ICU at KFSH. We excluded ICU and hospital staff, all children, those who refused to participate in the study, and other visitors who did not visit ICU. This study was carried out during visiting periods between September 2019 and October 2019.

### Sample size

The population of Tabuk city is 910030. The calculated sample size is 384 and surveys to obtain a confidence level of 95% that the real value is within  $\pm 5\%$  of the measured/surveyed value.

### Data collection

We are investigated one variable using descriptive questions. The questionnaire was divided into three parts. The first part was demographic data, including gender, age, educational level, and occupation of visitors who attended to ICU in KFSH. The second part was observing whether visitors were rubbing hands before the entrance and after exiting from ICU and then asking visitors if he/she washed their hands. The third part consisted of well-defined, clear questions to examine visitors' knowledge regarding hospital-acquired infection; the questions were answered by visitors or answered by helping from investigators.

We asked a total of 7 questions to assess the awareness of participants toward HAI & hand hygiene. A scoring system was made for this assessment with a total of 7 points. Each question was given 1 point if answered correctly and 0 point if answered mistakenly. The total score was then utilized to classify the awareness score into categories. Those correctly answering 50% or less (3 questions or less) of the questionnaire were categorized into the low awareness group, whereas those correctly answering above 50% of the questions (4 questions or more) were categorized into the moderate to high awareness group.

### Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (IBM SPSS Statistics) for Windows, version 26 (IBM Corp., Armonk, N.Y., USA). Categorical variables were presented as frequency and percentage, and chi-square or Fisher's exact test was used. The associations with  $p$ -values  $\leq 0.05$  were considered statistically significant.

## 3. RESULTS

A total of 381 persons participated in this study. Most participants were males ( $n = 239$ , 62.7%), while 109 (28.6%) were females, and 33 (8.7%) did not register their gender. Most participants' ages were 31-45 years followed by 18-30 years (33.3%). Regarding educational level, 7 participants (1.8%) stated they are uneducated, 42 (11%) stated they had elementary or intermediate education, 103 (27%) stated that they had high school education, 94 (24.7%) stated they had bachelor or diploma education, 1 (0.3%) stated having Ph. D. or Master education, and 134 (35.2%) did not register (Table 1).

**Table 1:** Demographic Profile of The Participants ( $n = 381$ ).

Demographical Characteristics	n	%
Gender		
Male	239	62.7
Female	109	28.6
Not Registered	33	8.7
Age Group		
18 - 30	127	33.3
31 - 45	145	38.1
46 - 60	62	16.3
61 & older	11	2.9
Not Registered	36	9.4
Educational Level		
Uneducated	7	1.8
Elementary / Intermediate	42	11.0
High school	103	27.0
Bachelor / Diploma	94	24.7
PhD / Master	1	0.3
Not Registered	134	35.2

**Table 2:** Attitude and Awareness Towards Hospital Acquired Infections and Hand Hygiene (n = 381)

	n	%
<b>Attitude Towards Hospital Acquired Infections and Hand Hygiene</b>		
Did the visitor use antiseptic solution before entering the ICU?		
Yes	283	74.3
No	98	25.7
<b>Awareness Towards Hospital Acquired Infections and Hand Hygiene</b>		
Did you hear about hospital acquired infections?		
Yes	194	50.9
No	187	49.1
It can affect any one in the hospital including patient, visitors, and health care workers?		
Yes (Correct)	289	75.9
No	62	16.3
I don't know	30	7.9
Pathogen can be transmitted from one person to another by hand?		
Yes (Correct)	292	76.6
No	66	17.3
I don't know	23	6
The visitors can transmit the infection to the patients?		
Yes (Correct)	299	78.5
No	58	15.2
I don't know	24	6.3
The ICU patients are at high risk to get the pathogen more than other?		
Yes (Correct)	268	70.3
No	85	22.3
I don't know	28	7.3
Hospital acquired infections are avoidable by simple precautions?		
Yes (Correct)	299	78.5
No	51	13.4
I don't know	31	8.1
Hand hygiene plays a major role in preventing the hospital acquired infections?		
Yes (Correct)	296	77.7
No	59	15.5
I don't know	26	6.8
Awareness Score		
Minimum – Maximum	0 - 7	
Mean ± Standard Deviation	5.08 ± 2.09	
Level of awareness		
Low level of awareness	71	18.6
Moderate to high level of awareness	310	81.4

The majority of ICU visitors did not perform hand hygiene (n = 283, 74.3%), while 98 (25.7%) only used antiseptic solution before entering the ICU. Nearly half (50.9%) of ICU visitors were heard about HAI before. Two-thirds of visitors believed that it could affect

any one at hospital including patients, visitors, and health care providers. Approximately more than two-thirds of visitors agreed that the visitors can transmit the infection to the patients, pathogen can be transmitted from one person to another by hand, and hand hygiene plays a major role in preventing the hospital acquired infections. The minimum score of awareness was 0, the maximum was 7 and the mean was  $5.08 \pm 2.09$ . Seventy-one (18.6%) had a low level of knowledge (scoring less than 50%), while 310 (81.4%) had moderate to high level of knowledge (scoring more than 50%), (Table 2).

Association between demographic variables and attitude towards hand hygiene before entering the ICU was assessed. A significant association was observed between gender and attitude towards hand hygiene before entering the ICU ( $p = 0.009$ ), whereas the better attitude towards hand hygiene before entering the ICU was noted from male compared to females (29.7% and 16.5%, respectively). No significant association was observed between neither age nor educational level with the attitude towards hand hygiene before entering the ICU (Table 3).

The association between demographical variables and awareness level towards hospital-acquired infections and hand hygiene was assessed. A significant relationship between gender and level of awareness was observed ( $p = 0.005$ ), whereas 85.8% of males had a moderate to high level of awareness compared to 73.4% of females. A significant association between educational level and awareness was also present ( $p = 0.042$ ), whereas higher rates of people with moderate to high awareness were noted as the educational level increased (71.4% in uneducated people, 76.2% in people with elementary or intermediate education, 87.4% in people with high school education, 93.6% in people with bachelor or diploma education, and 100% in the people with Ph.D./Master). No significant association was noted between age group and level of awareness (Table 4).

**Table 3:** The Association Between Demographical Variables and Attitude Towards Hand Hygiene before Entering ICU

Demographical Characteristics	Attitude Towards Hand Hygiene before Entering ICU		P-Value
	Yes	No	
Gender			
Male	71 (29.7%)	168 (70.3%)	0.009*
Female	18 (16.5%)	91 (83.5%)	
Age Group			
18 – 30	33 (26%)	94(74%)	0.944
31 – 45	42 (29%)	103 (71%)	
46 – 60	16 (25.8%)	46 (74.2%)	
61 & older	3 (27.3%)	8 (72.7%)	
Educational Level			
Uneducated	1 (14.3%)	6 (85.7%)	0.729
Elementary & Intermediate	9 (21.4%)	33 (78.6%)	
High school	29 (28.2%)	74 (71.8%)	
Bachelor / Diploma	28 (29.8%)	66 (70.2%)	
PhD / Master	0 (0%)	1 (100%)	

\*Significant at level 0.05

**Table 4:** The Association Between Demographical Variables and Awareness Level Toward Hospital Acquired Infections and Hand Hygiene

Demographical Characteristics	Awareness Level Toward Hospital Acquired Infections and Hand Hygiene		P-Value
	Low	Moderate to High	
Gender			
Male	34 (14.2%)	205 (85.8%)	0.005*
Female	29 (26.6%)	80 (73.4%)	
Age Group			
18 - 30	19 (15%)	108 (85%)	0.075

31 - 45	27 (18.6%)	118 (81.4%)	
46 - 60	14 (22.6%)	48 (77.4%)	
61 & older	5 (45.5%)	6 (54.5%)	
<b>Educational Level</b>			
Uneducated	2 (28.6%)	5 (71.4%)	0.042*
Elementary & Intermediate	10 (23.8%)	32 (76.2%)	
High school	13 (12.6%)	90 (87.4%)	
Bachelor / Diploma	6 (6.4%)	88 (93.6%)	
PhD / Master	0 (0%)	1 (100%)	

\*Significant at level 0.05

**Table 5:** The Association Between Attitude Toward Hand Hygiene before Entering ICU and Awareness Level Toward Hospital Acquired Infections and Hand Hygiene.

Demographical Characteristics	Attitude Toward Hand Hygiene before Entering ICU		P-Value
	Yes	No	
Awareness Level Toward Hospital Acquired Infections and Hand Hygiene			
Low Level of Awareness	16 (22.5%)	55 (77.5%)	0.496
Moderate-High Level of Awareness	82 (26.5%)	228 (73.5%)	

Significant at level 0.05

The association between attitude towards hand hygiene before entering ICU and awareness level towards hospital-acquired infections and hand hygiene was evaluated. Despite observing a slightly better attitude in people with a higher level of awareness, no significant relationship between the level of awareness and attitude was present (Table 5).

#### 4. DISCUSSION

Patients admitted to ICU are at high risk of contracting infections, which could contribute to worsening of their condition, with increased morbidity and mortality (Adams et al., 2011). Evidence shows that hospital visitors either perform HH inappropriately or does not perform it at all (Randle et al., 2010; Birnbach et al., 2015; Al-Dorzi et al., 2014). However, visitors get in contact with the skin of patients, which can result in transmission of pathogens from their contaminated hands to the patient (Cohen et al., 2012; D'Agata et al., 2009). The present study was carried out to determine HH compliance of ICU visitors as well as knowledge of visitors towards HAI.

A total of 381 persons were included in this study. Most participants (62.7%) were males and nearly half the participants had good level of education (completed high school, university degree, or postgraduate studies).

We found that the majority (74.3%) of ICU visitors did not perform hand hygiene, while only 25.7% used antiseptic solution before entering the ICU. All previous studies agreed that the rate of HH compliance among visitors is poor. However, the reported rates varied widely. Our rate was in agreement with the reported rates of HH compliance by Al-Dorzi et al. (2014) and Linam et al. (2019). Al-Dorzi and colleagues (2014) conducted a clinical audit at the ICU of King Abdulaziz Medical City, Riyadh, Saudi Arabia. They found that the technique of HH was inappropriate in 24% of ICU visitors (Al-Dorzi et al., 2014). Moreover, Linam and colleagues (2019) assessed compliance with HH among families and visitors attending neonatal ICU at Arkansas Children's Hospital, USA (Linam et al., 2019). The baseline compliance was 27% but increased markedly during implementation of a project to improve family and visitor HH to 79%. Further increase in the rate of compliance was observed following the addition of just-in-time education to a median of 85%.

A higher rate was reported by Randle and colleagues (2013) who assessed compliance with HH among healthcare workers, children, and visitors in two pediatric wards in an English hospital. They found the rate of HH compliance among visitors to be 38.5% (Randle et al., 2013). On the other hand, much lower rates, ranging from 7% to 19%, were reported by previous studies in hospital lobby and wards (Hobbs et al., 2016; Kouni et al., 2014; Fakhry et al., 2012). The wide variation in reported rates of compliance may be attributed to differences across the studies in the hospital location (lobby, ward, or ICU) and in the characteristics of visitors

included (such as educational level). In addition, some hospitals implement HH-compliance improving projects and are expected to have higher rates of compliance.

Poor compliance with HH among visitors is commonly attributed to lower educational level and inadequate knowledge about HAI and HH. Another probable cause is the presence of a theory-practice gap, as visitors have adequate knowledge but seem reluctant to perform HH (Mortell, 2012). The latter factor is potentially the main cause underlying poor HH compliance. This supposition is supported by our results as we attempted to investigate whether defective knowledge was affecting the visitors' attitude towards HH. We found that more than two-thirds of visitors knew that they could transmit infection to patients, pathogen can be transmitted via hand, and HH plays a major role in preventing the HAIs. Most (81.4%) participants had moderate to high level of knowledge, which was significantly associated with educational level. However, compliance with HH was not significantly associated with age, educational level, or level of knowledge, although a slightly higher level of knowledge was found in visitors with HH compliance.

Interestingly, we found a significant association between HH compliance and gender as compliance was observed in 29.7% of men compared to 16.5% of women. No definite cause could explain this difference. However, the men outnumbered women in our sample, and the awareness level of men was significantly higher than that of women. This suggests that gender may have produced a confounding effect on the rate of compliance in each gender. A multivariate regression analysis would have adjusted for potential confounders, but the sample size was not adequate for such analysis.

This gap between theory and practice was observed also by Birnbach et al. (2015) who found that visitors who did not comply with HH might have thought that HH should only be performed by health care workers (Birnbach et al., 2015).

There is an urgent need to improve the rates of HH compliance among visitors to hospitals. Raising awareness is important, but as our study results point, high awareness level may not be a sufficient solution to this problem. The use of clear, appropriate, and validated signage is important as they may act as reminders to increase the rate of compliance with HH. The placement of these signages inside the ICU before the visitors reach patients is also important and effective as demonstrated by Linam and colleagues (Linam et al., 2019). Moreover, providing specific instructions to visitors by health care workers before entering ICU can significantly improve the rates of compliance. It is also important to ensure adequate supply of sanitizers and facilities for hand wash before entering as well as inside the ICU. Visitors should be informed about the location of these supplies as they may not be familiar with the ICU design.

Improving the rate of HH compliance among visitors can potentially have a positive effect on the rates of compliance among health care workers by engaging them in HH quality improvement projects and providing instructions to visitors. Direct verbal instructions may be more effective in reminding visitors of HH compared to passive signage (Cohen et al., 2012).

The present study has several points of strength, as HH practice was observed directly, not assessed only through questionnaire, and potential factors that may affect compliance were investigated. However, there were some points of limitation. Visitors were not assessed from their entry into the hospital as they may have performed HH in the hospital lobby and thought it is not necessary to repeat the procedure before entering the ICU. In addition, it would have been better if observation of HH practice was done by video surveillance rather than direct observation. We did not assess the variation in HH compliance between daytime and night shifts as some studies reported differences in compliance rates in relation to shift time.

Future studies with larger sample sizes are recommended to adjust for potential confounders and to identify risk factors, which significantly contribute to non-compliance with HH. It is recommended also that these future studies should interview the visitors to identify the underlying reasons behind non-compliance.

## 5. CONCLUSION

The rate of compliance with HH is low among ICU visitors in the current study, which is in line with rates reported by previous studies. The main plausible reason for this low rate is theory-practice gap as knowledge about HAI and HH were good in our sample. However, there is still a role for raising awareness among visitors. These findings warrant the implementation of projects to increase compliance of HH among visitors. The use of signage, direct verbal instructions, and real-time reminders can effectively achieve this goal.

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### Authors' contributions

Albaraa Altowijri: Primary author read and approved the final manuscript.

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### Conflicts of interest

The authors declare that there are no conflicts of interests.

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### Informed consent

Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

### Ethical approval

The study was approved by the Medical Ethics Committee of the University of Tabuk, Tabuk, Saudi Arabia (ethical approval code: READ 0049).

### Data and materials availability

All data associated with this study are present in the paper.

### Peer-review

External peer-review was done through double-blind method.

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